Hydraulics & Pneumatics

SPECIAL REPORT: COMPONENT DEVELOPMENTS

MAY 1961

FLUID POWER AROUND THE WORLD

EDITORIAL DEPT
UNIVERSITY MICROFILMS
313 NORTH FIRST ST INC
ANN ARBOR MICH
41-6221A

Hydraulic Transfer Mechanisms

Tracer & Programmed Servos Combine on Welder

Understanding Contamination—Part 2

Cam/Pilot Valves Give Smooth Furnace Door Operation

High Efficiency Pumps Synchronize Die Loader

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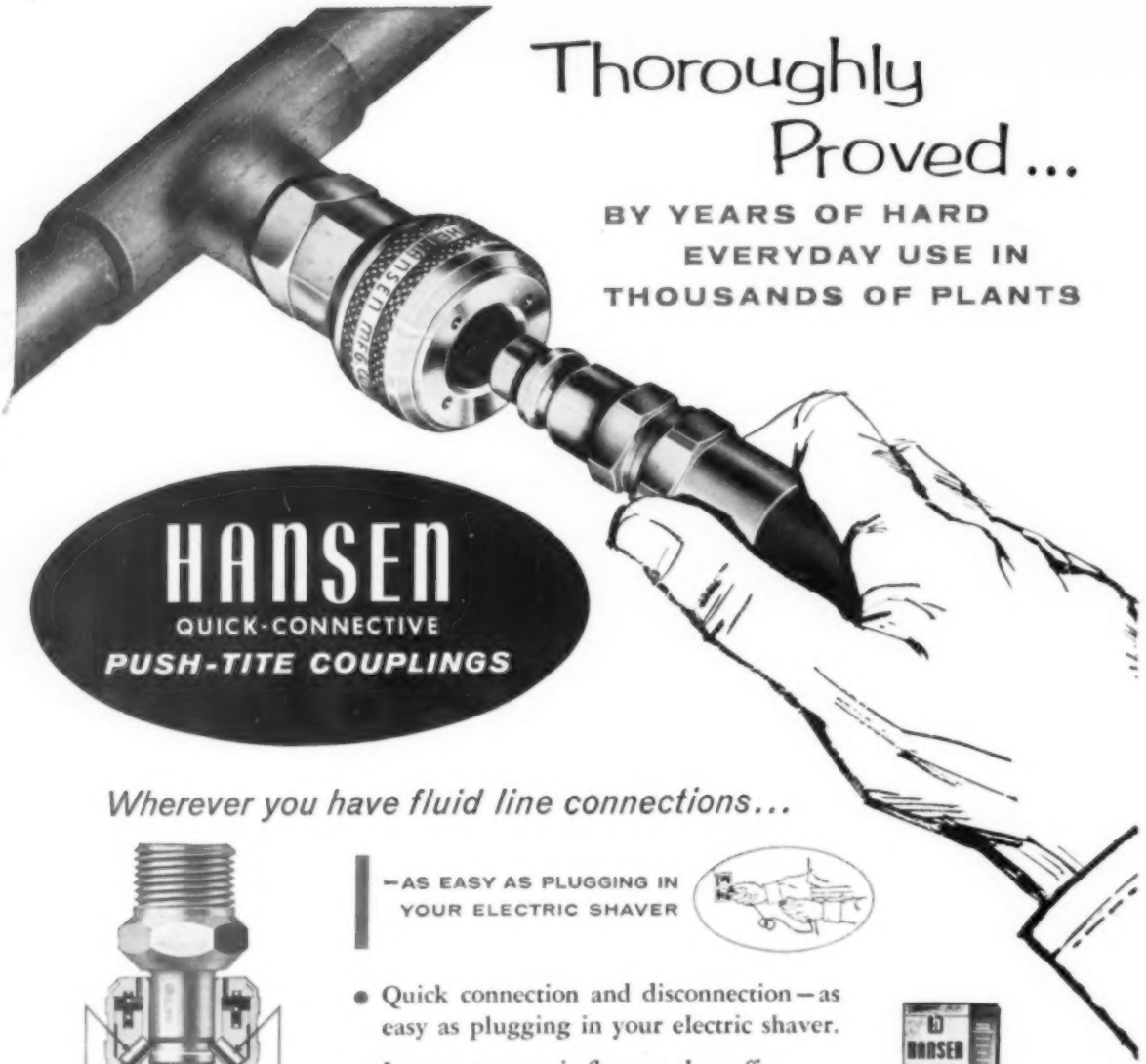

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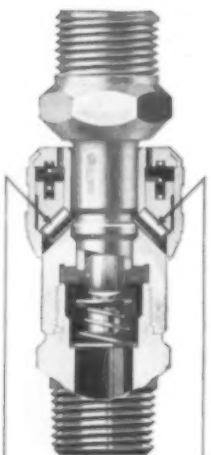

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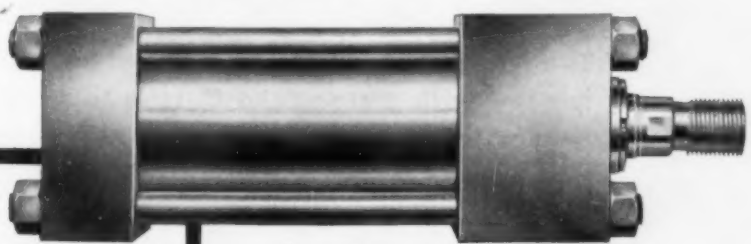

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The KAPSEAL® is a Teflon® "boot" which is used with a standard O-ring to provide a good seal with superior frictional and wear characteristics.

LONG LIFE The KAPSEAL has been tested on dynamic installations in both the laboratory and the field with outstanding results. Tests have run over 4,000,000 cycles before they were discontinued, while a hydraulic control valve has logged over 2,000,000 cycles. On a rod-seal installation it is performing satisfactorily at 1500 PSI.

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KAPSEAL is a trademark of Minnesota Rubber Co.
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FOR MORE INFORMATION ON THE KAPSEAL . . .

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VOLUME 14/NUMBER 5

MAY 1961

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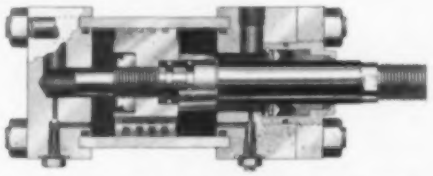

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- Delivery from stock!

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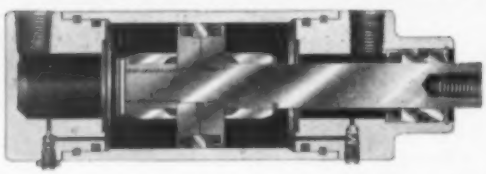

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USEFUL LITERATURE

NEW CATALOG FOR REPLACEMENT LINE OF ANCHOR HYDRAULIC HOSE ASSEMBLIES, COUPLINGS, HOSE AND FITTINGS

For better, faster service for users of fluid power equipment requiring replacement hydraulic components, the Anchor Coupling Co. Inc. consolidated catalog—No. D-2 describes the complete *replacement* line of Anchor Pressed-On Hydraulic Hose Assemblies, together with Anchor Reusable Couplings, Hose and Fittings. These Anchor products are carried in stock for immediate pick-up or delivery from Anchor distributors.

Prepared for quick reference, selection and ordering, catalog No. D-2 shows the comprehensive Anchor line of Pressed-On Hose Assemblies.

Anchor Super-Spiral Wire Reinforced High Pressure Hydraulic Hose Assemblies with Pressed-On Couplings, offering the highest burst and working pressures available in hydraulic hose assemblies, are completely described, with detailed specifications.

In addition, the new Catalog shows Anchor high pressure Pressed-On Hydraulic Hose Assemblies for extra strength Two Wire Braid, standard Three Wire Braid, and extra strength Three Wire Braid Hose.

Featured are Anchor's high pressure Two Wire Braid hose (SAE 100R2) assemblies with Pressed-On, Clamp-Type or Coverstrip Reusable Couplings, together with Anchor's medium and low pressure One Wire Braid (SAE 100R1) Assemblies with Pressed-On Couplings or Reusable Couplings. For non-flammable hydraulic fluids (Phosphate Esters), Anchor's High Pressure Two Wire Braid Hose Assemblies with Pressed-On Couplings are recommended.

Medium and low pressure One Wire Braid Cotton Cover Hose (Style QW-SAE 100R5) and One Wire Braid Rubber Cover Hose (Style QWR) Assemblies with Duloc Reusable Couplings are illustrated.

Described in detail are Anchor Max-Flo Hi-Burst Two Rayon Braid Hose (Style HR-SAE 100R3) and standard Style R Two Rayon Braid Hose Assemblies with Pressed-On, Clamp-Type and Reusable Couplings.

For suction, low pressure or gravity flow hydraulic lines, Anchor Max-Flo Spiral Wire Reinforced Suction Hose (Style SW-SAE 100R4) Assemblies with Pressed-On or Clamp-Type Couplings are shown.

Also illustrated are Anchor Style PR Rubber Cover 1-Cotton Braid Hose and Style PQ Cotton Cover 1-Cotton Braid Hose Assemblies with Anchor Hold-Fast Couplings for low pressure automotive, marine and industrial applications.

The Couplings section of Catalog No. D-2 gives detailed specifications for Anchor high, medium and low pressure Clamp-Type Reusable Couplings and Coverstrip Reusable Couplings for Two Wire Braid hose (SAE 100R2) and One Wire Braid Hose (SAE 100R1); DULOC Reusable Couplings for Style QW (SAE 100R5) and Style QWR hose; Reusable Couplings for Hi-Burst and standard Two Rayon Braid, Style HR (SAE 100R3) and Style R hose.

Described in detail are Anchor 4-Bolt Split-Flange "O" Ring Head Clamp-Type Couplings for use with the above mentioned hose. Also included are Anchor Split Flanges and components. Anchor's Hold-Fast Reusable Couplings, in a wide variety of styles and sizes, are described.

The Anchor line of Adapter Unions, Adapters, Pipe Fittings and SAE Boss Fittings for hydraulic and industrial uses, with the largest variety of three combinations—standard, JIC, SAE, etc.—is included in the new catalog.

Copies of Anchor No. D-2 Catalog are available at Anchor distributors, or can be obtained by writing direct to Anchor Coupling Co. Inc., 318 North Fourth St., Libertyville, Illinois.

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THE PLEDGE OF PERFORMANCE

Where threaded-type connectors can be eliminated . . . Anchor's field proven Industrial Hydraulic Flanged Tube, Pipe and Hose Connections, Four Bolt Split-Flange Type make excellent units for connecting (1) hose assemblies to valve or pump parts; (2) hose to manifold; (3) pipe to pipe; (4) pipe to hose; and (5) hose to hose . . . in high, medium and low pressure systems. There are no threads to wear or tapered seats to groove with these Anchor fittings.

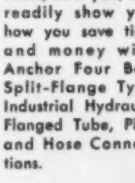
Universally accepted by original equipment manufacturers for their *complete reliability* under all operating conditions . . . these Anchor fittings are leak and blow-off proof . . . trouble-free . . . easier to connect or disconnect, especially in tight spaces.

The distinctive Anchor design of Four Bolt Split-Flange Type, Industrial Hydraulic Flanged Tube, Pipe and Hose Connectors eliminates costly pipe threading operations, separate unions and swivel connections, enabling users to disconnect and reconnect hose lines many times without damage or leaks.

Available in flange sizes ranging from ½" to 5".

Write today for Anchor Catalog No. 403 which gives complete specifications.

Andy Anchor says: "Anchor field engineers, near you, can readily show you how you save time and money with Anchor Four Bolt Split-Flange Type Industrial Hydraulic Flanged Tube, Pipe and Hose Connections.



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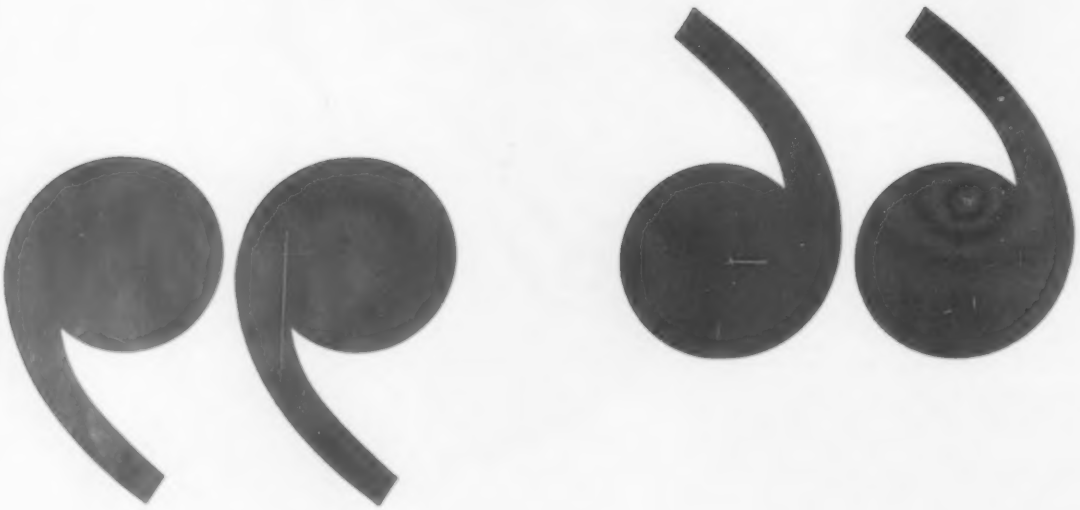

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Fluid Power news

OILGEAR 40 Years of Fluid Power

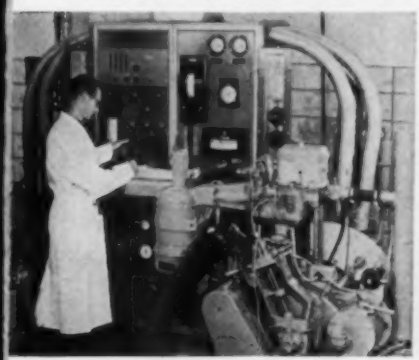
Report No. 12,400 From Oilgear *Application-Engineering* Files

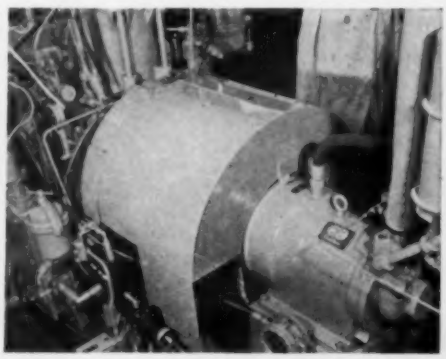
HOW OILGEAR-ESSO RESEARCH TEAMWORK SOLVED NEED FOR MORE COMPACT, LOWER COST, RELIABLE, HIGHLY ACCURATE, DYNAMOMETER AND STARTER SYSTEMS

USER: *Esso Research and Engineering Corp., Linden, New Jersey*

PROBLEM: New Equipment to conduct the exhaustive, standardized performance tests on all new fuels and lubricants, as required by the oil companies and engine manufacturers — to guarantee top-quality petroleum products for optimum consumer engine performance. These extended tests — carefully recorded and regulated from operating control centers — are performed with *standard test* engines coupled to load-absorbing dynamometers. Cradled, expensive electrical load absorbers were previously used to provide test engine control.

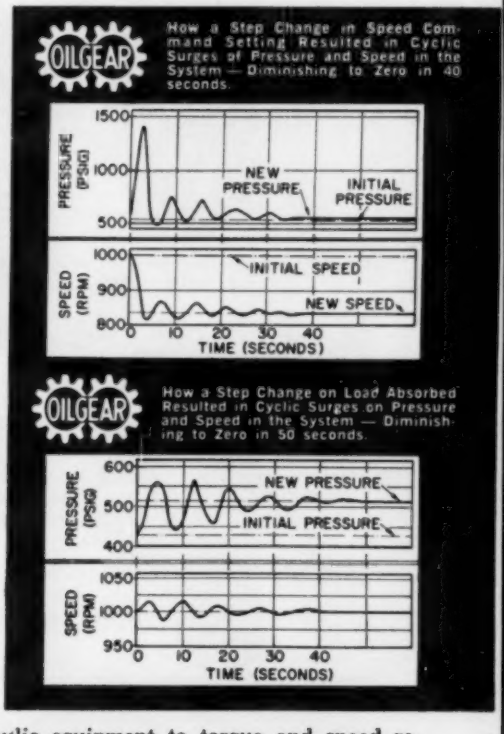
ESSO RESEARCH REQUIREMENTS FOR A NEW DYNAMOMETER SYSTEM WERE: 1. Sharply reduce installed cost and valuable test floor space. 2. Insure absolutely reliable, precise, loading and speed control over continuous periods up to 1,000 hours per test. 3. Simplify test engine starting methods — normally 50-hp motors are used to overcome high starting torques, due to heavy flywheels and high internal friction. 4. Long life, maximum trouble-, and maintenance-free durability.





LEFT: One of the **Oilgear-Esso Research** centralized control centers for complete recording, regulation, control, and operation of two test engines, and the Oilgear servo-valve-controlled Dynamometer and Starters connected to them. **RIGHT:** Rear view of 5¼" bore by 8" stroke, Standard Single Cylinder Test Engine with Oilgear servo-valve-controlled Dynamometer/Starter. This efficient, compact, Oilgear pump/motor unit is shaft-coupled to the test engine . . . cranks the engine for starting — then absorbs all power produced during testing. Other system equipment — Oilgear servo-valve "Power Paks" that regulate the loads imposed on the test engines and Oilgear remote, air-controlled Type "DA" Variable Displacement Pump used for starting the test engines — are mounted on the floor above to free valuable test floor area for additional testing units.

SERVOCONTROL* — Single-Stage, Four-Way Servo Valve without enclosure . . . exclusive "**Swing-Plate**" design . . . only one moving part . . . no metal-to-metal contact . . . as used with this installation.
*A Division of The Oilgear Company



SOLUTION: A completely new servo-valve-controlled *Dynamometer and Starting System* was *Application-Engineered* by Oilgear's Servocontrol Division. In addition to meeting all engine control and starting requirements, these new systems were installed *at 50% of the cost of comparable "universal" electric dynamometer systems.* Addition of two more test units to this system will result in a saving of 65% for the four-ganged arrangement. The unusual, centralized starting system has adequate capacity to start a large number of test engines — one at a time — and maintain the required supercharge on the dynamometer pump/motors during test-loading. Oilgear loading Pump/Motors permit more compact installations than equivalent capacity alternate systems. Simple safety interlocks protect the equipment. and guarantee positive, correct operating sequence of all starting and loading test procedures.

ESSO RESEARCH REPORTS — *"Other than installed cost and space saving, the prime requirement of this dynamometer was to maintain a constant speed for variations in temperature, engine torque, etc. This system maintains an accuracy of 1 rpm at an engine speed of 1000 rpm — or a speed accuracy of 0.1%.*

Information contained in this Fluid Power News Report is condensed from a paper entitled, "Electro-Hydraulic Dynamometer and Starter for Laboratory Test Engine" — by J. W. Broome, Chief Engineer, Servocontrol Division of The Oilgear Company, and R. L. Van Voorhies, Senior Engineer, Mechanical Division, Esso Research and Engineering Company . . . presented at the NCIH — Chicago, Illinois. OILGEAR — SERVOCONTROL *are trademarks of The Oilgear Company.*

By sizing the hydraulic equipment to torque and speed required, these same fundamental components can be applied to other dynamometer applications . . . and for controlling other variables. OILGEAR-SERVOCONTROL can supply *everything* a carefully engineered system requires . . . reduce delays, costly machine downtime due to malfunctioning, and actually save you money on engineering, components wiring, piping, installation and testing costs — PLUS the assurance that only a "single-source, single-responsibility" can give.

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Synclinal SUMP TYPE

CAPACITIES:
5—8—10—20—30—50—75 and 100 G.P.M.

PIPE SIZES:
¾"—1"—1¼"—1½"—2"—2½" and 3".

CONNECTIONS:
Coupling—Male Nipple.

BY-PASS VALVE:
Not Available.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants, all types of Fire-resistant Hydraulic Fluids and Water.

Tandem Synclinal SUMP TYPE

Designed to supply requirements for greater filtering area where installation of two or more single units are not possible due to space limitations in tank.

PIPE SIZES:
¾"—1"—1¼"—1½"—2"—2½" and 3".

CONNECTIONS:
Coupling—Male Nipple.

BY-PASS VALVE Not Available.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants and all types of Fire-resistant Hydraulic Fluids and water.

Bonded SUMP TYPE

CAPACITIES:
10—20—30—50 and 75 G.P.M.

PIPE SIZES:
1"—1¼"—1½"—2" and 2½".

CONNECTIONS:
Coupling—"O" Ring—Male Nipple.

BY-PASS VALVE:
Available with or without By-Pass Valve.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants and all types of Fire-resistant Hydraulic Fluids.

SYNCLINAL FILTERS

on all hydraulic and other low pressure circulating systems

Synclinal LINE TYPE

CAPACITIES:
5—8—10—20—30—50—75 and 100 G.P.M.

PIPE SIZES:
¾"—1"—1¼"—1½"—2"—2½" and 3".

BY-PASS VALVE:
Not available.

OPERATING PRESSURES:
Up to 80 p.s.i.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants, all types of Fire-resistant Hydraulic Fluids and Water.

Bonded LINE TYPE

CAPACITIES:
10—20—30—50 and 75 G.P.M.

PIPE SIZES:
1"—1¼"—1½"—2" and 2½".

MOUNTING BRACKET: All sizes are available with provision for mounting bracket, (also for Flange connection with mounting bracket provisions) if desired.

BY-PASS VALVE:
Available with or without.

OPERATING PRESSURE:
Up to 250 p.s.i.

OPERATING TEMPERATURES:
Up to 300° F.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants and all types of Fire-resistant Hydraulic Fluids.

IN-LINE FILTER

CAPACITIES:
Up to 60 G.P.M.

PIPE SIZES:
(at both inlet and outlet)
¾"—1"—1¼" and 1½" **NPTF.**
1 11/16-12, 1 5/8-12 and 1 7/8-12 **J.I.C.**

FLANGE CONNECTIONS:
1¼" and 1½"

BY-PASS VALVE:
Available with or without By-Pass Valve.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants and all types of Fire-resistant Hydraulic Fluids.

QUALITY
DEPENDABILITY
EFFICIENCY

QUALITY—All Marvel Synclinal Filters are designed and constructed of the highest quality materials and workmanship to insure maximum protection on all hydraulic and other low pressure circulating systems. *They Meet J. I. C. Standards.*

DEPENDABILITY—The dependability of Marvel Synclinal Filters is attested by the fact that—OVER 900 Original Equipment Manufacturers install them as standard equipment.

EFFICIENCY—Filtering media in all Marvel Synclinal Filters is Monel wire cloth and available in mesh sizes of 20-30-40-50-60-80-100-150 and 200. Stainless wire cloth in these sizes supplied on specification. Before fabrication into Marvel Synclinal Filters, all wire cloth is subjected to rigid inspection at our plant to assure the utmost in filtration efficiency. *Only selected top quality wire cloth is used.*

EASY MAINTENANCE—All Marvel Synclinal Filters can be cleaned easily and thoroughly "on the spot" in a matter of minutes, resulting in the equivalent of a brand new filter, ready for another long period of efficient and dependable service.

Line type filters operate in any position and may be serviced without disturbing pipe connections.

IMMEDIATE DELIVERY
A phone call will start your shipment on its way TODAY!

For Further Information, Wire, Write or Phone

MARVEL ENGINEERING COMPANY

7227 North Hamlin Ave. • Chicago 45, Illinois • Phone JUniper 8-6023

Please send me information on Marvel Filters as indicated. AH-5

☐ Sump Type ☐ In-Line ☐ For Hydraulic Oil ☐ For Coolants or Lubricants
☐ Line Type ☐ Tandem ☐ Fire Resistant Fluids ☐ For Water

Name _____

Company _____

Address _____

City _____ Zone ____ State _____

FLUID POWER LINES

from editor to reader

A COMMON LANGUAGE . . . Working with authors from Japan to Australia (by way of Holland) is an experience in international relations. For this month's feature on *Fluid Power Around the World* we've relied heavily on high school French, conversion factors from metric to English systems, and a somewhat superficial knowledge of Japanese grammar. But the common language that has broken through national barriers is the basic technology of fluid power. Control of acceleration and deceleration by cam valves, valve modifications to control deadband, cylinder synchronization—these are problems that concern designers all over the world. Some of the answers are in this month's articles.

And we would like to pay our compliments to ASA symbols. They're universal and a great help in tracing circuitry. Companies which have promoted the use of these symbols can take much of the credit for advancing hydraulics and pneumatics as an engineering science.

SERVOVALVES AND CONTAMINATION . . . Servovalves are the big reason for all the hubub about contamination in hydraulic and pneumatic systems. Continuing his series on *Understanding Contamination*, in this month's Aerospace Section, Convair's Howard Davis analyses servovalve designs and how they are affected by contamination.

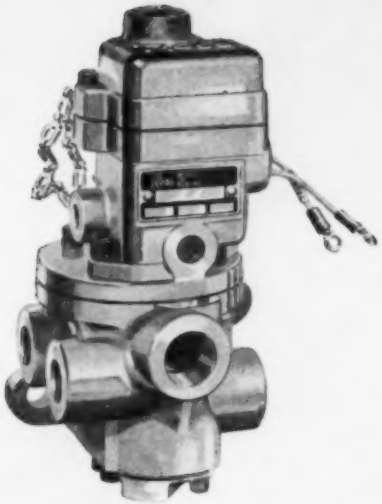
STERILIZING WITH RADIATION . . . We don't know what happens when a person is hit with gamma radiation, but a hydraulically driven conveyor in Britain's Atomic Energy installation was designed to keep anyone from finding out. The task of keeping boxes moving smoothly through the intricate conveyor system is accomplished by ingenious arrangements of mechanical and hydraulic controls.

LITTLE RED HEN . . . One thing she didn't worry about was how the miller packed the flour from her grain of wheat. But in a real flour mill, packing consistency is a concern. Hydraulic speed characteristics of the Australian equipment described in *Metering Valve Controls Density of Flour* give the required control and flexibility.

SYNCHRONIZE . . . A slightly different spelling in French, but exactly the same problem the world over. Monsieur Affouard of Hydrem in Paris achieved it with high efficiency, reciprocating plunger pumps, and radial piston motors. The design is explained on page 108.

OPEN AND SHUT CASE . . . Operating 25-ton furnace doors in a steel mill is a job for hydraulics' smooth control. Jar them and you'll damage the brick lining. The Dutch article. *Cam/Pilot Valves Give Smooth Furnace Door Operation* explains circuitry and mechanics of the door system.

POLAR WELDING . . . Programming a welder in one plane would seem like a job for two cylinders mounted perpendicular to each other for two-axis control. But in the design explained in *Tracer and Programmed Servos Combine on Welder* a system of polar coordinates is used. The correct radius and angular speed keep the welding head following the seam on a tractor C-frame. The welding head is tracer controlled along an arm which rotates around a programmed turret.



this small valve can do a big valve's work

Ross

NEW "HEADLINE" SERIES

This story has made the Ross Headline valve series a "standard" in the world of valvedom in just six short months. There is nothing "exotic" about it. Our designers and manufacturing engineers have simply been able to create an economical inline valve that will pass a greater volume of air, valve size-for-valve size, than any other valve made. The Headline valve thus in many instances permits you to use a smaller valve than you could use before. Since this has been done without compromising Ross traditional quality, and long-life is thus taken for granted, the "Headline" series then represents probably the best valve value available today. Straightways, 3-ways and 4-ways. Pipe sizes, ¼" through 1½".

Call your Ross representative or write for Bulletin 323.

For other Ross valves see our catalog in Sweets Product Design File.

Ross OPERATING VALVE COMPANY

105 EAST GOLDEN GATE AVE. • DETROIT 3, MICHIGAN

YOU REDUCE COST WITHOUT SACRIFICING QUALITY

when you specify B&W Lectrosonic J.I.C. Hydraulic Line Tubing

J.I.C. Standards for hydraulic fluid line applications now permit the use of welded or seamless steel tubing on an equivalent basis. B&W Lectrosonic® welded carbon steel tubing meets all such J.I.C. Standards—and has been proved by 6 years of rugged B&W field testing. What's more, B&W Lectrosonic tubing is produced under the most rigid quality control procedures in the industry. Tests are made before, during and after manufacture. The key phase: 100% ultrasonic inspection of the weld in line production. The result: superior electric-resistance welded tubing that does the job of seamless while it maintains the low cost advantages of welded.

See how B&W Lectrosonic tubing can meet your hydraulic line requirements. Just call your B&W District Sales Office or write for Bulletin T-435. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

B&W

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TUBULAR PRODUCTS DIVISION

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Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

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Circle 118 →

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. . . in economical power application

98% PLUS OPERATING EFFICIENCY
MORE POWER PER CYLINDER DOLLAR
PROVEN LEAKPROOF OPERATION
GREATEST SELECTION EVER OFFERED
SAFE UNDER SEVERE LOADS
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SAFE UNDER TEMPERATURE EXTREMES
DAMAGE-PROOF PISTON RODS

Miller HYDRAULIC CYLINDERS

Flick-Reedy . . . *Winner of "Plant of the Year" Award and "Silver Anvil" Public Relations Award*

Miller

MORE SAVINGS!

Our ultra-modern, new "Plant of the Year" with its special facilities and operating economies enable us to offer an **extra 10% price savings** on our big "stock" selection of:
Model "H" (Hyd.) Cylinders, 1½" through 8" bores;
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Model "A" (Air) Cylinders, 1½" through 14" bores.
Strokes up to 36", cushioned and non-cushioned.

Full Details On Request

Miller Hydraulic Cylinders make impossible applications look easy. With Teflon Seals, Case-Hardened Rods (50-54 Rockwell C), Patented "Shef" Tubing End Seals, and other exclusive *standard* features, these cylinders are practically damage-proof, are ultra-dependable under pressure and temperature extremes, and provide leakproof sealing with ALL hydraulic fluids. Built to *exceed* J. I. C. Specifications, these cylinders are achieving new highs in production and operating economies in thousands of plants. Two great lines: Power-Packed Model H for 3000-5000 psi and Job-Rated Model J for 500-2500 psi. All bores, strokes and mounting styles. Big "Stock" selection for immediate shipment at substantial savings.

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MILLER FLUID POWER

DIVISION OF FLICK-REEDY CORPORATION

7N017 York Road, Bensenville, Illinois

AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS

"But, Mother, does he have to talk about Houdaille's HydRoAc *all* the time?"

Poor fellow. He's just found out about the newest and most complete line of hydraulic rotary actuators and he wants *everybody* to share his brilliant discovery. At the moment he's explaining that Houdaille's HydRoAc comes in five different sizes, with 100 different variations to solve almost any commercial rotary actuator problem. And before he's through, he'll point out that each HydRoAc unit is compact and powerful, with efficiencies to 95% or over. Be the first in *your* neighborhood to learn the exciting facts about Houdaille's HydRoAc. Spark up your conversation with such gems as "foot or end mounted", "operable on air or other media", "snubbing over last 5° of travel", "temperature range from -40° to 275°F.", "lowest internal leakage", "torque range from 1500 to 741,000 in. lbs." Send now for your free conversation starter, the Houdaille HydRoAc Rotary Actuator catalog.

... Specialists in rotary type hydraulic equipment

Houdaille Industries, Inc.

Buffalo Hydraulics Division, 545 E. Delavan Ave., Buffalo 11, N. Y.

BEST BUY
IN THE COMPACT FIELD TODAY

NEW WATTS
FILTER – REGULATOR – LUBRICATOR

You know what it's like to design a system and then find oversized components driving weight and costs up.

But no more. Now you can specify this compact Watts assembly for applications where (1) space is limited or (2) you have low flow requirements.

You don't sacrifice a thing! Dependable Watts filter has 20 micron porous bronze element. Exclusive Watts by-pass principle gives optimum lubrication at flow rates from .2 to 15 CFM with negligible pressure drop. Fill plug and oil feed adjustment are interchangeable front to rear. Maximum pressure is 150 PSI. Two sizes — ⅛" and ¼".

Write for complete information. Watts Regulator Company, Industrial Division, Lawrence, Massachusetts

Visit Watts Booth 2006 ASTME Tool Exposition

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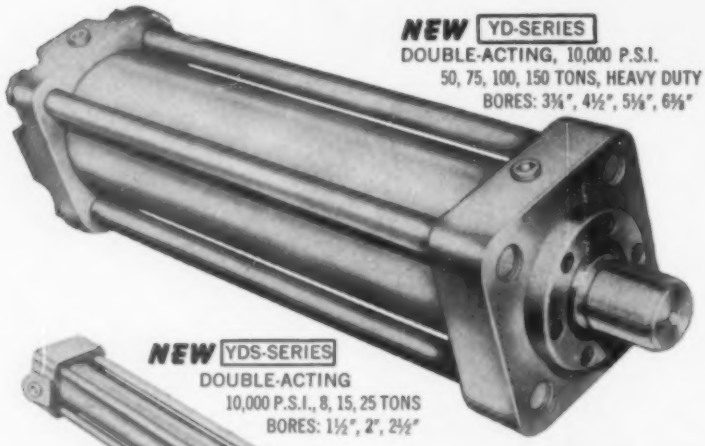

NEW YD-SERIES
DOUBLE-ACTING, 10,000 P.S.I.
50, 75, 100, 150 TONS, HEAVY DUTY
BORES: 3¼", 4½", 5⅛", 6⅝"

NEW YDS-SERIES
DOUBLE-ACTING
10,000 P.S.I., 8, 15, 25 TONS
BORES: 1½", 2", 2½"

CENTER HOLE

NEW YDT-SERIES
DOUBLE-ACTING
10,000 P.S.I.
17, 30, 50 TONS
BORES: TWO 1½", TWO 2", TWO 2½"

CENTER HOLE

Y-SERIES
SPRING RETURN
10,000 P.S.I.
17½, 30, 50, 100 TONS

YS-SERIES
SPRING RETURN
7-9,500 P.S.I.
2, 4, 7, 10, 20, 50 TONS

New OTC 10,000 p.s.i. Hydraulic Cylinders

- PRECISION BUILT, POWERFUL, COMPACT, LIGHTWEIGHT
- THE FIRST ADVANCES FROM OTC'S NEWLY FORMED "PRECISION HYDRAULICS DIVISION"

OTC 10,000 P.S.I. hydraulic cylinders open new possibilities in "hi-pressure" designing by meeting high force requirements with compact, lightweight components. Cylinders are precision built for dependable, continuous performance. Choice of stroke length and standard or tie-rod extension mountings for YD, YDS and YDT series cylinders. Requests for quotations invited.

New two-stage and single-stage 10,000 P.S.I. hydraulic pumps and power packages also available.

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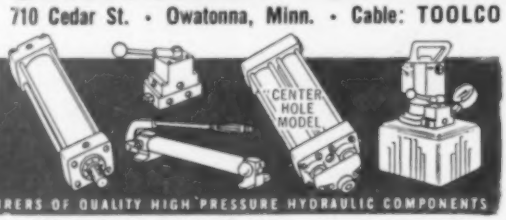

DESIGNERS AND MANUFACTURERS OF QUALITY HIGH PRESSURE HYDRAULIC COMPONENTS

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LETTERS to the editor

Address your letters to: The Editor, HYDRAULICS & PNEUMATICS MAGAZINE, 812 Huron Rd., Cleveland 15, Ohio.

Wants NCIH papers

TO THE EDITOR:

Please send one copy of the following technical papers presented at the 16th NCIH at Sherman Hotel, Chicago 1960:

- Hydraulic Filtration Systems, by H. C. Zintz.
- White Room Instrumentation, by A. V. Sada.
- Contamination Control In Missile Hydraulic Systems, by W. A. Riehl.
- Control of Hydraulic Fluid Contamination, by D. R. Walker.
- Hydraulic Fluid Contamination Sources, Their Recognition and Control, by C. B. Davis and G. L. Wenner.
- Filtration In Aircraft and Missile Systems, by H. L. Wheeler Jr.
- Surgical Cleanliness—Where?, by R. Q. Sharpe and K. G. Hendriksson.

Flygvapnet
Centrala Flygverkstaden
Malmslatt
Sweden

For copies of these papers, we suggest that you write to Mr. William Smith, National Conference on Industrial Hydraulics, Illinois Institute of Technology, Technology Center, Chicago 16, Illinois. He may have copies of these papers to send to you. Otherwise, a book of proceedings is published for each conference. This is not yet available for the 1960 conference.

Design problems for hydraulics course

TO THE EDITOR:

Do you have an outline or other material for a course in hydraulics? I am particularly interested in example problems which include procedures for designing components and require sufficient engineering data to give the student some practice. Any literature that you have will be useful as a reference in the new course which

Continued on page 18

NYLON PRESSURE TUBING

for Hydraulic-Pneumatic Service

On one design after another, Garlock Nylon Pressure Tubing proves superior to other materials. One specific instance concerned a hydraulically-controlled wheel dresser. The hose lines draped over the multiple-head grinders and fouled the controls. This not only impeded operation, but looked bad from an appearance standpoint. Nylon Pressure Tubing was applied. As a result, tubing cost was reduced by 70%, and installation time was cut to a minimum. Because of the self-supporting feature of the tubing, "draping" of the line was eliminated; this made operation safer, improved overall design of the wheel dresser.

In cost, too, Garlock Nylon Pressure Tubing has the advantage. Seamless copper and extruded aluminum is approximately four times as much, while welded and seamless stainless steel costs 29 to 37 times more, respectively. Also, the cost of couplings and installation labor should be considered—Nylon Pressure Tubing needs no intermediate couplings or fittings . . . is simple to install. You save on first cost, fittings, and labor.

An outstanding design material. Garlock Nylon Pressure Tubing is unaffected by oils, alkalies, hydraulic fluids and solvents that corrode metals . . . resists vibrational fatigue, abrasion, impact . . . withstands temperatures from −60°F to +300°F . . . available in 1000 and 2500 p.s.i. burst ratings, conforming to J.I.C. specifications. Diameters from ⅛" O.D. to largest size commercially made.

For more data, call your representative at the nearest of the 26 Garlock sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalog AD-177. Garlock Inc., Palmyra, N.Y.

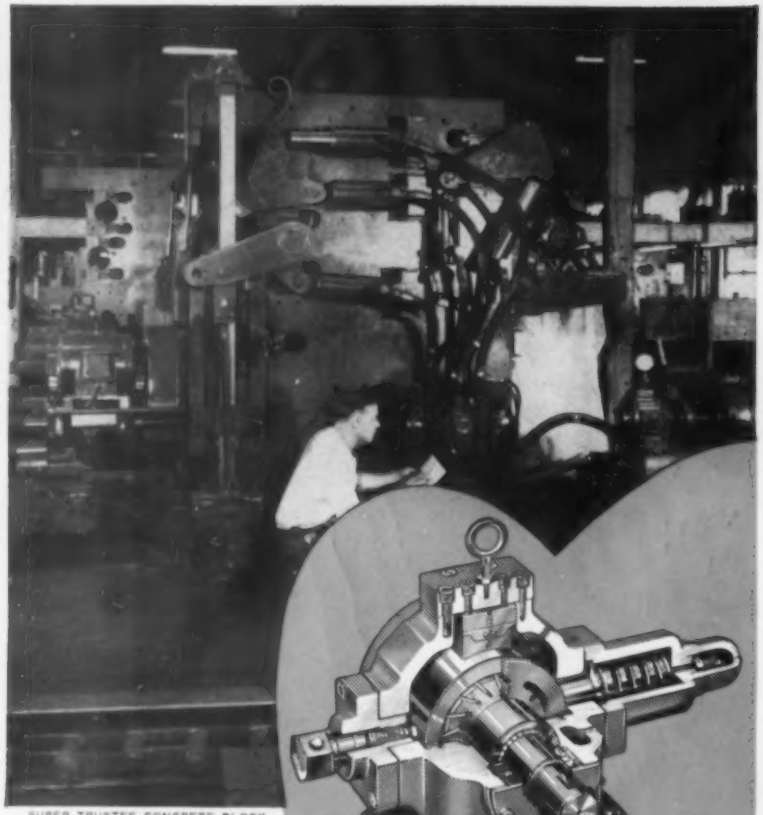
Canadian Div.: Garlock of Canada Ltd.

Plastics Div.: United States Gasket Company

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

Garlock Nylon Pressure Tubing can be twisted, flexed, bent . . . ideal for hydraulic-pneumatic systems, pressure lubrication lines, oil and fuel lines, vacuum connections.

GARLOCK



SUPER TRUSTEE CONCRETE BLOCK MACHINE BUILT BY THE GENE OLSEN CORP., ADRIAN, MICHIGAN

This dependable hydraulic heart

The heart of this 1100 blocks per hour concrete block machine is a
RACINE
MODEL 8R PUMP

REDUCES UPKEEP AND DOWN-TIME BY AS MUCH AS 80%

"RACINE HYDRAULIC EQUIPMENT is the *heart* of our concrete block machines," says C. S. DeLamater, sales manager for The Gene Olsen Corp., another satisfied user of RACINE PUMPS and VALVES exclusively since 1949. Besides the tremendous savings in operating hydraulically-designed concrete block machinery, the firm emphasizes the advantage of simplified control of oil circulation in RACINE VARIABLE VOLUME PUMPS. They pump *only* the oil required to do the job — no waste of pressure oil — no heating. Thus through lower horsepower, operation economies are enjoyed.

RACINE
Racine Hydraulics & Machinery, Inc.
RACINE, WISCONSIN
HYDRAULICS DIVISION

Circle **142** on Reader Service Card

LETTERS

I plan to teach in hydraulic systems and hydraulic power transmission.

B. A. STOUT
Associate Professor
Agricultural Engineering Dept.
Michigan State University
East Lansing, Michigan

We have sent outlines for two courses which have been given in Cleveland. One concentrates on hydraulic components. The other emphasizes circuit design. We are also enclosing a problem in using JIC symbols in circuits and a simple exercise in circuitry and cylinder selection.

Transmission lines for hydraulic motors

TO THE EDITOR:

Have you any technical information on transmission lines for furnishing power to a number of hydraulic motors, each with a capacity of approximately 15 gpm at 1000 psi to 1500 psi.

If you do not have this information, could you put us in touch with some hydraulic expert or organization?

PAYNE DEAN
Payne Dean & Co.
Clinton, Conn.

We have suggested a fluid power distributor in your area. We are sure he can offer technical assistance in working out your design.

Basic circuit manual

TO THE EDITOR:

A few years ago, you published a 32-page manual describing "Fluid Power Circuits" for applications using JIC symbols.

Would you please send us three copies of this manual for use by our local engineers.

W. F. BLIEVERNICHT
Bellows-Valvair
Atlanta, Georgia

Copies of this manual are no longer available. However, this information is incorporated in our "Fluid Power Directory."

Continued on page 20

Circle **154** →

Ordinary hydraulic fluid made from mineral oil is ignited by open flame. Torch is 18 inches from nozzle orifice.

Shell Irus 902 Hydraulic Fluid, in the same test, refused to be ignited by 3000-degree flame.

BULLETIN:

3000-degree flame does not ignite Shell Irus 902—the fire-snuffing hydraulic fluid that helps make factories safe from fire

Shell forced Irus® 902 Hydraulic Fluid through a .145-inch orifice at 1000 psi pressure. The Irus Fluid was sprayed from the orifice and a 3000-degree flame thrust into the streaming fluid. Irus was not ignited.

Read the advantages of economical Shell Irus 902 and how it can protect your plant.

IRUS 902 is the fire-snuffing hydraulic fluid that protects lives and equipment.

How Irus works

Irus 902 is an ingenious combination of oil and water. The water is encased in a film of oil. In technical terms, it is a 100% water-in-oil emulsion.

But unlike other emulsions, Irus 902 has optimum stability. This is vitally important. It means that Irus Fluid will retain its lubricating qualities far longer than unstable oils—and will not allow the water to separate out. Result: the water stays in the oil, ready to snuff a fire if needed.

Other advantages

1. Cools off systems. Because of its high rate of heat transfer and high heat capacity, Irus 902 can allow hydraulic systems to run cooler.

2. Resists thickening and thinning. The viscosity of Irus 902 is tailored to protect pump parts during the entire working cycle—from cold start-up to hot, continuous operation.

3. Saves gaskets, packing, hose. Irus 902 is gentle to nonmetallic parts as well as metal. It can be used almost anywhere that you'd use mineral oil.

4. Resists foaming. Irus 902 does not hold captive air. If air is introduced, Irus 902 quickly releases it.

5. Easier to spot leaks. Irus 902 is bright yellow, helps you spot leaks quickly.

For complete details about changing over to Shell Irus 902, contact your nearest Shell Industrial Products Representative. Or write: Shell Oil Company, 50 West 50th Street, New York 20, N. Y.

A message to manufacturers of hydraulic equipment

Shell Irus 902 makes an excellent initial fill.

1. It is available anywhere in the U.S.A.

2. Quality of Irus Fluid is consistently high. It must meet strict Shell specifications.

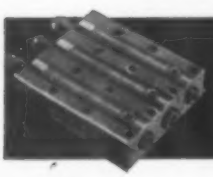
SHELL

A BULLETIN FROM SHELL
—where 1,997 scientists are working to provide better products for industry.

for DEPENDABLE HYDRAULIC PRESSURE CONTROL

Low price and high quality make FULFLO piston-type hydraulic valves a natural O.E.M. choice. The service they deliver . . . quiet, dependable and trouble-free . . . makes them ideal from the equipment users' viewpoint.

- Screw or flange models . . . to 500 lbs. . . . for pipe sizes to 3"
- Steel, cast iron or brass bodies . . . brass, steel or stainless trim
- Fast shipment of standards . . . specials to your requirements



NEED A "Special"?
FULFLO can engineer a special valve to your most exacting requirements. Examples of "specials" are shown in Data Book.

FOR EXTRA CONTROL CONVENIENCE
Request new, illustrated catalog of FULFLO Hand Wheel Valves . . . used where frequent pressure setting is needed.

Request complete catalog from:

The FULFLO SPECIALTIES CO., Inc.
415 Fancy Ave., Blanchester, Ohio

FULFLO

Circle **66** on Reader Service Card

LETTERS

Stainless hose coupling source

TO THE EDITOR:

We are anxious to find a source of stainless steel, insert-type, hose couplings in both male and swivel female in ¼", ⅜", ½", ¾", 1", 1¼", and 1½" NPT.

This should be a supplier that ordinarily maintains a stock of this material and can make immediate shipments, in both large and small quantities.

Anything you can do to help us with our supply problem would be appreciated. All of the above couplings will be used on a product which we manufacture for resale.

J. DANER
President
Cobon Plastics Corp.
Newark, N. J.

We are sending you a copy of our January 1961 issue which lists manufacturers of hose fittings. These are shown in selection charts on page 122. Their addresses are given on page 186. You should find a supplier among these companies.

Pneumatic computing relay information

TO THE EDITOR:

I am interested in obtaining information on pneumatic computing relays, their function, theory etc. I would especially appreciate information about published literature and books.

ERNEST F. LOBNER
Design Engineer
Cameron Machine Co.
Dover, N. J.

We have sent names of companies manufacturing this type of equipment. Perhaps readers have further suggestions.

Designers Guide correction

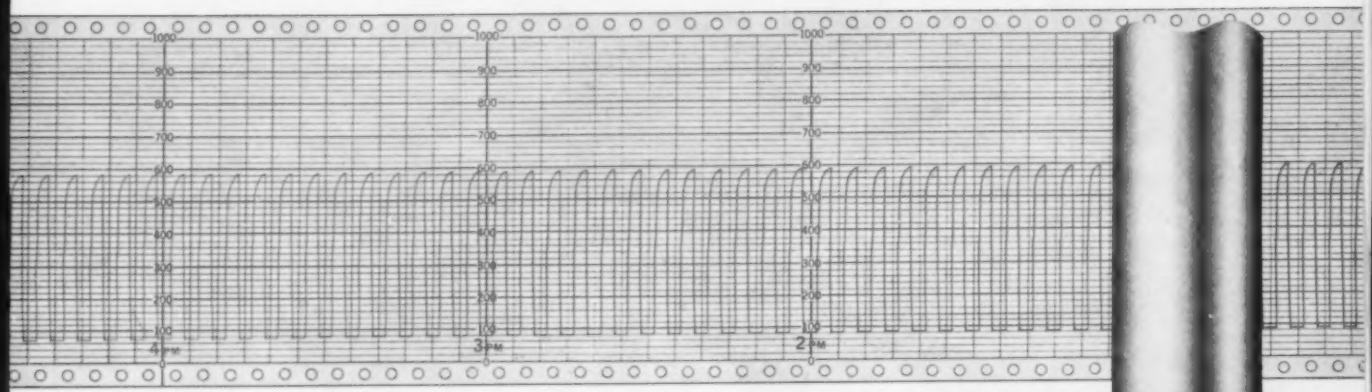
In the January 1961 Designers Guide Issue, Hydraulic Research & Mfg. Co. should have been included in the selection chart on servovalves.

Circle **50** →

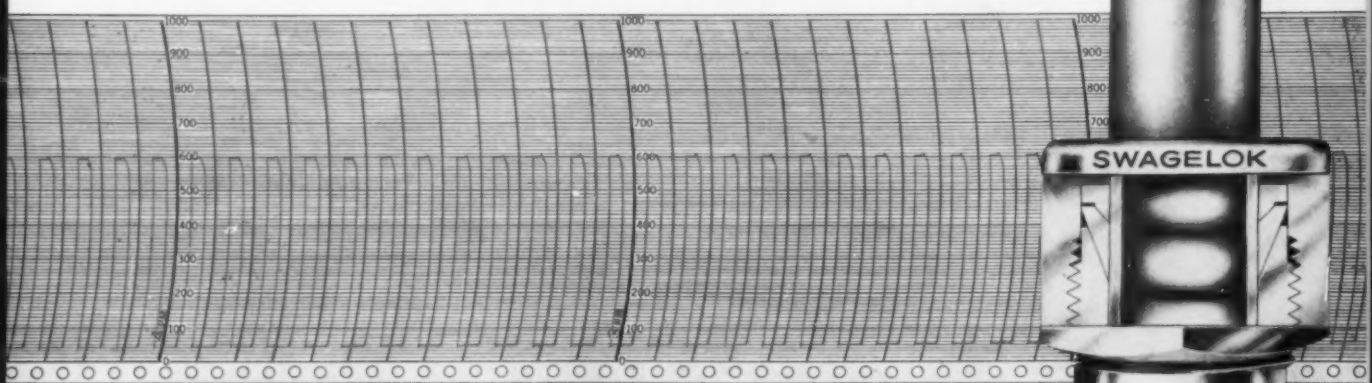
Severe Thermal Shock and Pressure Tests prove that

Swagelok® TUBE FITTINGS

SOLVE YOUR PROBLEMS



TEMPERATURE VS TIME RECORDING: The peak temperatures 580° to 600° F. occurred during the maximum pressure period. 750° F. steam was used but inability to keep insulation intact due to severity of the thermal shocks limited the maximum temperature. The minimum temperatures occurred during the cold water flush.



PRESSURE VS TIME RECORDING: The maximum pressures on the chart were produced by 600 psi superheated steam at a source temperature of 750° F. The minimum pressures were the result of opening the system dump valve and flushing with 50° F., 500 psi cold water.

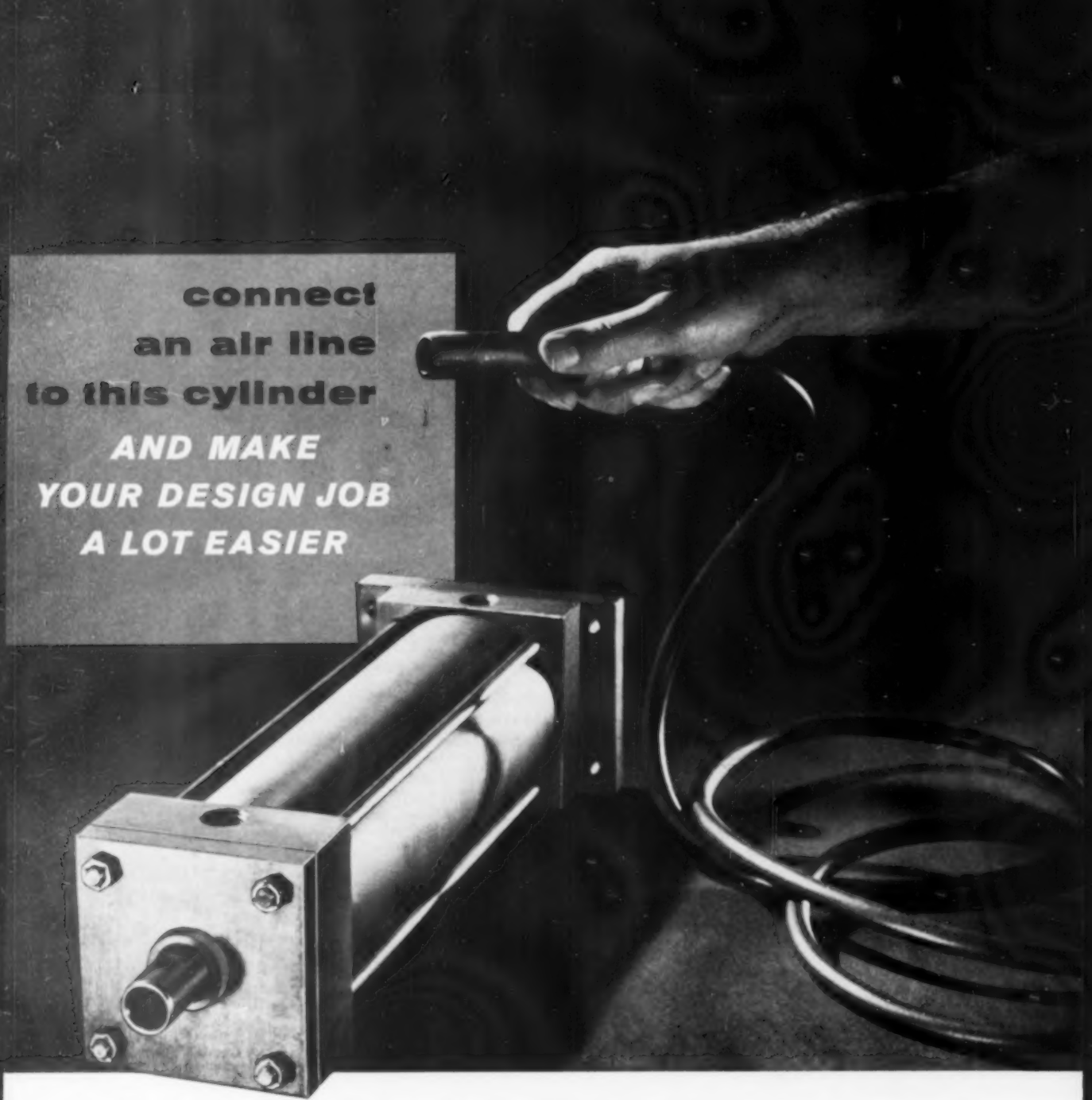
The tests recorded on the above charts were conducted on one inch carbon steel hydraulic tubing (ASTM-A-179) using carbon steel SWAGELOK Fittings. Thirteen to sixteen SWAGELOK Tube Fitting connections were in the systems and 1200 severe thermal shocks were applied on each of two different tubing configurations without leaks or failure. The conditions used in this test were considered casualty or mal-operation conditions and are not recommended practice for any system design.

These tests prove that for steam system instrumentation and steam tracing service, SWAGELOK Tube Fittings solve your problem.

Visit SWAGELOK Booth 1108 at the Design Engineering Show, Cobo Hall, Detroit, May 22-25, 1961

Swagelok® TUBE FITTINGS

Crawford Fitting Company • 884 East 140th Street • Cleveland 10, Ohio • Crawford Fittings (Canada) Ltd., Niagara Falls, Ontario, Canada



The cylinder simplifies your design work substantially, because it produces virtually any kind of motion—and does so *without the use of complex mechanical contrivances!*

It provides constant, even pressure at all times, and this pressure can be varied with a simple adjustment. Its compact size, along with the use of a flexible line, makes it easily adaptable to special machine design.

If you would like more information about cylinders, or the many other Logan products, just fill in and mail the coupon below.

LOGAN

AIR AND HYDRAULIC OPERATED MACHINES

Check the items you want, fill in your name and address, tear out and mail to:

Logansport Machine Co., Inc. • 70C Center Avenue, Logansport, Indiana

___100-1 AIR CYLINDERS	___200-1 HYD. POWER UNITS
___100-2 MILL-TYPE AIR CYLS.	___200-2 ROTOCAST HYD. CYLS.
___100-3 AIR-DRAULIC CYLS.	___200-3 750 SERIES HYD. CYLS.
___100-4 AIR VALVES	___200-4 and 200-7 HYD. VALVES
___100-5 LOGANSQUARE CYLS.	___200-6 SUPER-MATIC CYLS.
___100-6 ULTRAMATION CYLS.	___ABC BOOKLET
___100-7 SUB-PLATE AIR VALVE	___CIRCUIT RIDER
___300-1 CHUCKS	___CALCULATOR
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NAME.....

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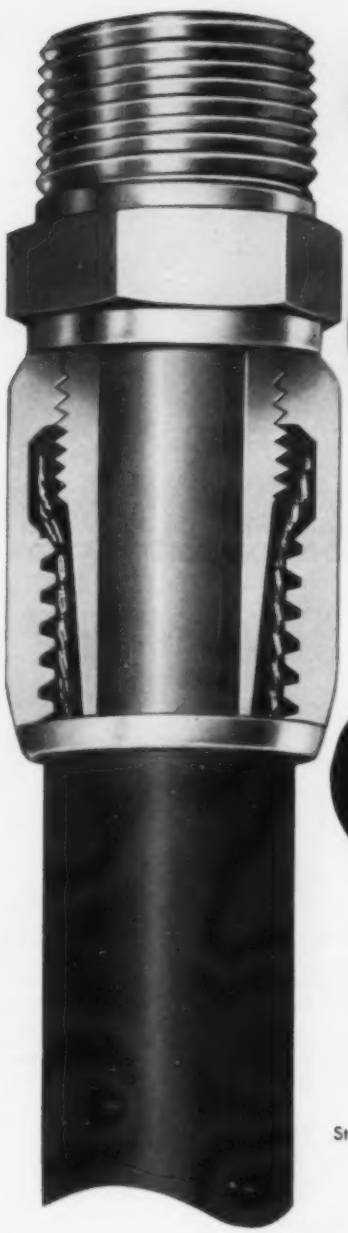
"The grip that never slips!"

SURGEPRUF®

NON-SKIVE ASSEMBLIES

give you five big design features you want!



reusable couplings

fast replacement

full-line selection

positive "no-leak" seal

40% longer hose life

INCORPORATE SURGEPRUF'S BIG DESIGN ADVANTAGES INTO YOUR HYDRAULIC EQUIPMENT!

Research proves non-skive hydraulic hose assemblies last 40% longer than skived assemblies. That means 40% less replacement cost! Here's why: the wire braid in Surgepruf's hydraulic hose is buried in rubber... stays buried in rubber. The result: a "super-seal" that literally fuses rubber to metal—prevents leaks.

Surgepruf's rugged hose meets SAE Hydraulic Standards' dimension, working pressure, and burst requirements—has wide temperature range—resists weather aging, abrasion, water, and oil. It's available in IDs from $\frac{3}{16}$" to 2".

Using Shur-Lock reusable couplings, these non-skive assemblies provide fastest on-the-job replacement. No special assembly tools are required.

IMPORTANT: Surgepruf's full line of interchangeable hose, reusable couplings, and adapters are always available from Alemite's many sales outlets coast-to-coast. Get full information and detailed specifications today... send for free Surgepruf catalog No. 40-25, today!

NHAMA

In Canada:
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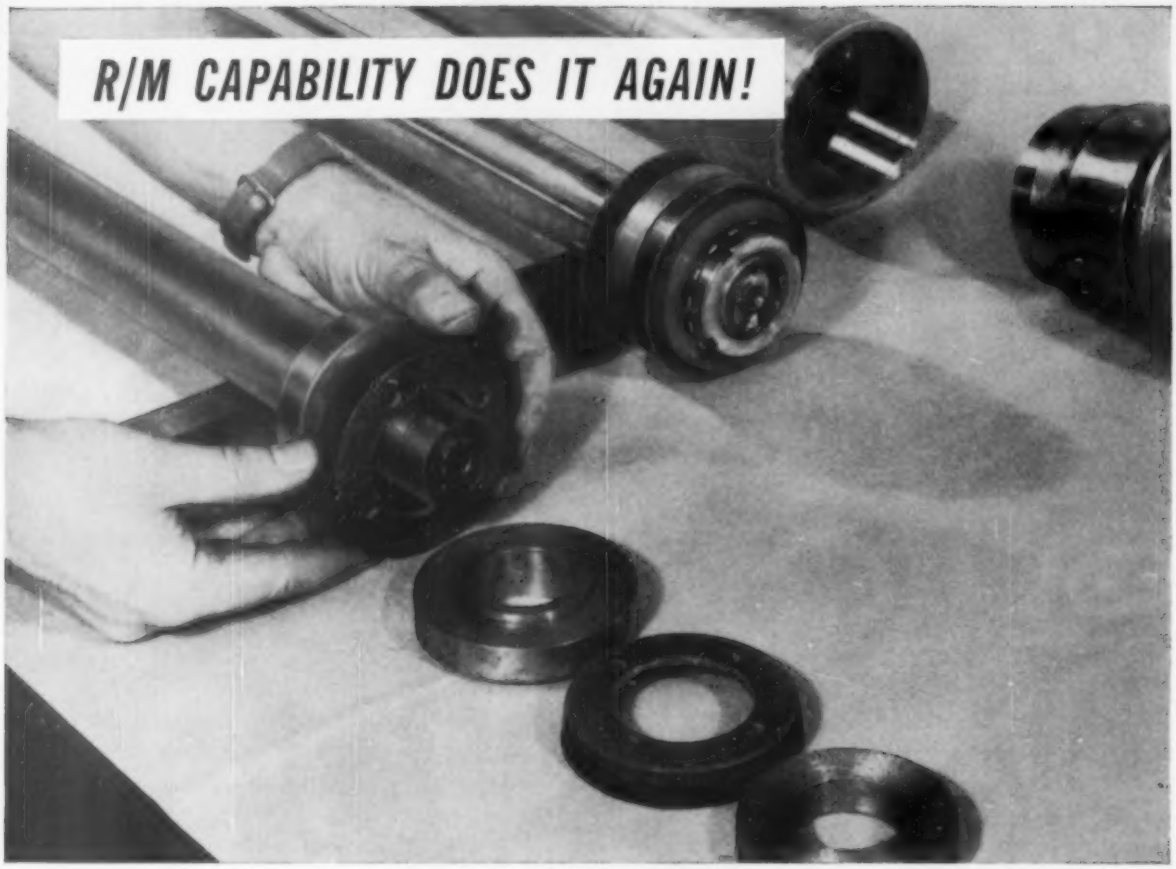
Belleville, Ontario

Symbol of SW Excellence

ALEMITE DIVISION
STEWART-WARNER CORPORATION

Dept. AG-51, 1850 Diversey Pkwy., Chicago 14, Illinois



Solves major operating problems for tire press manufacturer with new Teflon*-impregnated molded asbestos piston cups

New molded asbestos piston cups impregnated with Teflon,* developed by Raybestos-Manhattan, Inc., have enabled National Rubber Machinery Company, Akron, Ohio, to improve the economy and efficiency of its Autoform Slideback Tire Press while realizing substantial savings. The new seal has not only reduced air loss to a minimum, but eliminated a lubrication system, cut maintenance, and increased machine operating life.

Before adopting R/M cups, NRM used metal rings for the ram and cylinder assembly. These did not provide the seal required, permitted a 5 to 10% air loss, caused excessive wear on moving parts, and required lubricants which were entrained, seeped into the molds, and damaged the tire rubber.

In considering a suitable replacement for the metal rings, NRM tested various synthetic rubber and leather cups. All deteriorated rapidly in temperatures up to 380°F. Then R/M was consulted. Preliminary investigation indicated asbestos with a Teflon filler as a potentially good combination for this application. Nearly a year of research, testing and engineering collaboration followed. Samples were developed and tested in the field under actual operating conditions. Only when all results were in—after two years—did NRM adopt R/M cups for use in all its presses.

R/M's experience in the manufacture of packings, gasket materials, and specialty products to meet the exacting and varied requirements of industry is at your disposal—whatever your need call on R/M.

Registered trademark for Du Pont fluorocarbon resins

The application of R/M piston cups provided two important benefits. It eliminated oil in the curing room, preventing damage to the tire rubber. It reduced air loss with properly fitted and installed cups.

RAYBESTOS-MANHATTAN, INC.
PACKINGS
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

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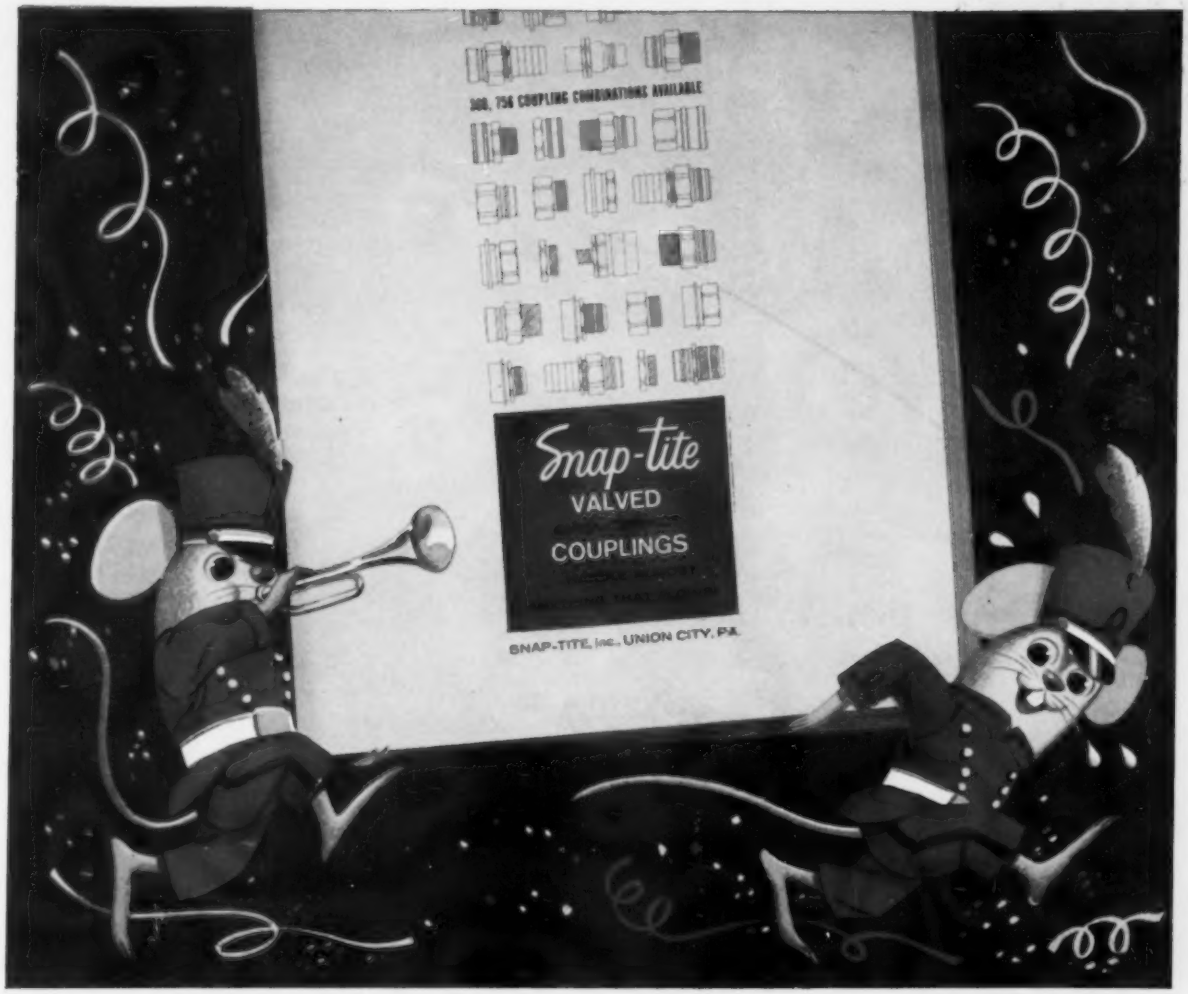

announcing—a dynamic new catalog for coupling users

complete specs on 308,756 possible coupling combinations

And it's hot off the press! This comprehensive new 62 page catalog contains complete information on all sizes and types of Snap-Tite quick-connect, quick-disconnect couplings for:

positive pressure applications; impact air tools; high pressure, vacuum and very low pressure; hard-to-handle fluids; no-spray applications; no-spill aircraft and missile applications.

Included are descriptive cutaway and exploded illustrations and complete weight and dimensional data for all sizes, ¼" to 6". Working pressures, flow, pressure drop and spillage data are also provided in detailed graphs and charts.

SPECIAL! RUBBER GASKET USAGE GUIDE SECTION
For the first time in the quick-connect coupling field, a compilation of complete selection data describing packer seals to use in handling over 300 fluids and gases.

Write today on your company letterhead for free copy!

Snap-tite

UNION CITY, PA.

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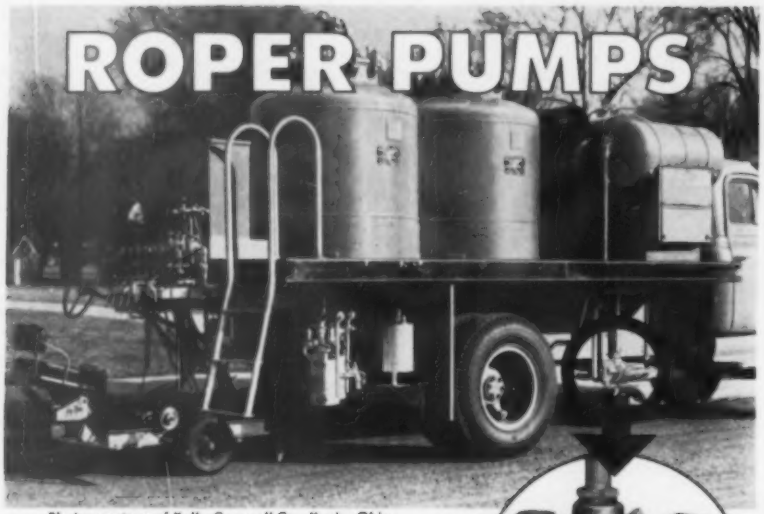

Photo courtesy of Kelly-Creswell Co., Xenia, Ohio

transfer paint from drums to pressure tanks on highway marking machine

• CAPACITY: 40-300 GPM • PRESSURE: 100 PSI

Roper Series 3600 pumps have been a dependable part of Kelly-Creswell highway zone marking machines for many years. The Series 3600 HBZRV-2A model transfers paint mixture from drums to pressure tanks, delivering trouble-free, low-maintenance service, even when handling light-reflective paint containing highly abrasive granules. Roper tank truck pumps are compact, complete units, built with drive shafts on upper or lower gears, depending on type of mountings to be used. Built-in steam chests are available. Series 3600 pumps are specified by many manufacturers of original equipment for the petroleum, process, packaging, and chemical industries for dependable service in handling a wide variety of liquids—thick or thin—under all kinds of industrial conditions.

GEARED TO THE ROUGHEST USE

- **TWO** equal sized, heat-hardened alloy helical gears are the only moving parts. Perfectly balanced construction, accurate machining, provide vibration-free service.
- **FOUR** heavy-duty, high-lead bronze or chrome-iron bearings, hardened for long service, support pumping gears.
- **PRECISION-GROUND** steel shafts are induction hardened at bearing and packing surfaces. Special shaft lengths are available to fit your equipment requirements.

For information about how Roper pumps can serve your equipment, contact your Roper dealer.

Send for "How to Solve Pumping Problems" booklet

ROPER HYDRAULICS, INC.

Dependable pumps since 1857

COMMERCE, GEORGIA

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FLUID POWER FORUM

Each month HYDRAULICS & PNEUMATICS surveys readers for their experiences and opinions in fluid power design.

• ***What improvements would you like to see in fluid power components?***

It seems to me there is need for a high torque, slow speed hydraulic motor, even at the cost of reduced efficiency. Suppose we make it comparable to a worm gear drive, gear head electric motor. Efficiency between the power source and output in this case is very low.

The advantages of eliminating the gear box on such applications as crane trolleys, hoist drives, handling gear, power door operators, and certain types of mobile equipment seem to outweigh the disadvantages if we had such an hydraulic motor. In many industrial applications, size, efficiency, and weight are not the first considerations.

P. EDWARDS
Engineer
Todd Shipbuilding Corp.
Seattle, Washington

We are limited by the fact that there does not seem to be available a precision air regulator able to handle high capacities. We need a regulator able to handle in the order of 140 scfm with about the same performance characteristics as a laboratory type regulator that is limited to less than 10 scfm.

C. HAREWOOD
Mechanical Engineer
Radio Corporation of America
Morristown, New Jersey

The improvements I would like to see in fluid components are standardization and compactness of units. As industry continues its trend toward automation, the need for standardization and compactness stands out.

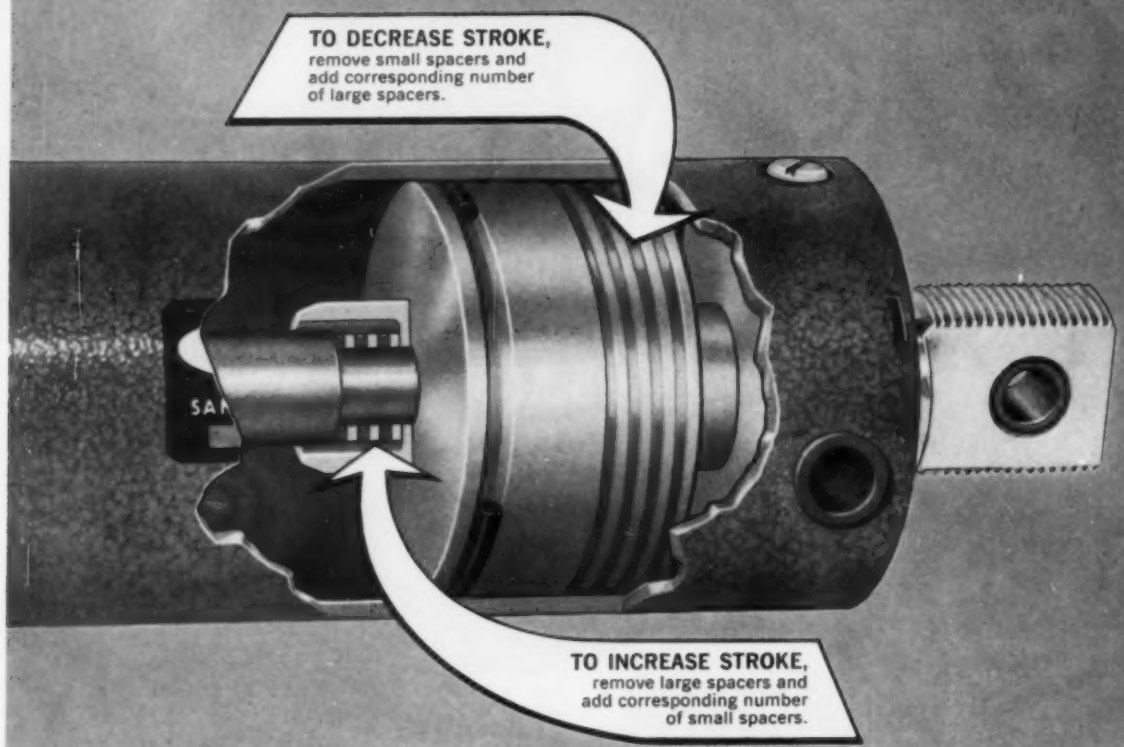
The size of the components necessary for a certain machine,

Continued on page 30

another **NEW FEATURE** *from* Modernair ® TRADEMARK

Adjust-O-Stroke

Trade Mark (U. S. Pat. No. 2,476,844)



"ADJUST-O-STROKE" offers the first practical way to tailor economical stock cylinder stroke lengths to your exact stroke requirements. Here's how it works: Modernair cylinders* are stocked in standard stroke lengths in 1" increments. If you want a 12⅜" stroke length, you buy a 13" stock cylinder. By changing the patented "ADJUST-O-STROKE" spacers as shown in the drawing, you reduce the 13" stroke length to 12⅜" with no change in mounting dimensions.

It simplifies your inventory and installation problems, reduces costs all along the line. "ADJUST-O-STROKE" is not a screw adjustment; it is a positive and precise means of getting the desired stroke length.

Why not get all the facts on Modernair's complete line of fluid power products? Call your local Modernair dealer (see your phone book yellow pages), or write us now for your copy of Modernair's 1961 general catalog.

"ADJUST-O-STROKE" is offered on Modernair Series M, Economair Series R, and Valve-in-Head cylinders (in 1½", 2", 3" and 4" bore sizes), and on Power Machine Control units.

Modernair ® Trademark **CORPORATION**

400 Preda Street • SAN LEANDRO, CALIFORNIA • Phone: LOckhaven 2-6485

5007 Brookpark Road • CLEVELAND 34, OHIO • Phone: SHadyside 9-6393

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Modernair Corporation

MEMBER NATIONAL FLUID POWER ASSOCIATION

The Purolator P32 Micronic® Filter makes short work of hydraulic system dirt. Stops it – before it gets a chance to wreck equipment and rob you of top efficiency and output. Here's how it works:

Greater filtering area. The Micronic® Filter is a resin-impregnated cellulose element that traps contaminants, leaving vital hydraulic systems clean. It is specially preformed and pleated for maximum filtering area.

Easy element change. The clamp-lock ring construction lets you change elements without disconnecting the filter unit from the system. Just unscrew the couplings, throw away the dirty element – and slip in the replacement.

Adaptable application. You can use one or two elements, whatever you need, and install units on either the pressure or suction side of the pump. The unit can withstand operating pressure up to 300 lbs.

The P32 series is a medium size line ranging in flow capacity from 15 to 30 GPM. It is 1 of over 2000 units available from Purolator, the world's most experienced filter manufacturer. For information, write: Purolator Products, Inc., Rahway. New Jersey.

Filtration For Every Known Fluid

PUROLATOR

PRODUCTS, INC.

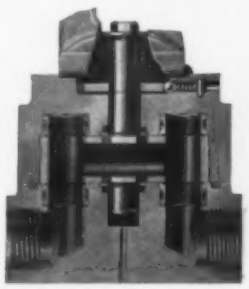
RAHWAY, NEW JERSEY AND TORONTO, CANADA

Circle **140** on Reader Service Card

REPUBLIC LO-TORQ SELECTOR VALVES

2, 3, 4-WAY SELECTOR 6000 psi

Design of the Lo-torq Seals provides perfect sealing under full pressure, reverse pressure, or no pressure in indexed positions. As line pressure increases seals become tighter, yet by use of the exclusive balanced step design, excessive friction is eliminated, and the remaining pressures counteract upon both sides of the valving disk. Result — low turning torque, with no leakage. Interflow and non-interflow models. Side, bottom or sub-plate connections. Pipe or tube, $\frac{1}{8}$ to 2 in. Readily panel mounted. Low and high pressure types. Air, gas — 2000 or 4000 psi max. Fuel, hydraulic oil, petroleum, water — 3000 or 6000 psi max.



SECTIONAL VIEW OF LO-TORQ VALVE

LO-TORQ SUB-PLATES

Republic Sub-plates provide a simple and quick way to mount valves. Without disconnecting lines, valves are removable for service or replacement. Bottom or side ports, pipe or tube up to 1 in.

3000 psi Mini-Lo-Torq

Miniature Selector Valve for directional control of small amounts of fluid at high pressures, for pilot control, and where space is at a premium. Maximum service 3000 psi, hydraulic or pneumatic. 2, 3, 4-way, $\frac{1}{8}$ and $\frac{1}{4}$ in. pipe or AND10050 tube ports. Panel mount Aluminum alloy.

10,000 psi Lo-Torq

Lo-torq Seals give leak-tite service in oil, air or water use up to 10,000 psi. Low turning torque. Additional control valves not needed. Body and internal parts, stainless steel. Panel mounting flange. 2, 3, 4-way, with $\frac{1}{4}$ to 1 in. internal pipe or AND10050 ports, standard. High pressure tube ports on special order.

RELIEF • CHECK • NEEDLE • PLUG • SOLENOID • MANIFOLD • GLOBE • SPECIALS

Republic produces several complete lines of pneumatic and hydraulic valves in sizes up to 2 in. Special valves and components engineered and manufactured to customer's specifications. Please consult us.

Stocking Distributors Coast to Coast

3573

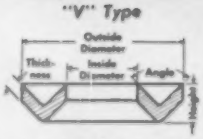
REPUBLIC MANUFACTURING COMPANY

MAIN OFFICE AND FACTORY
15655 Brookpark Road, Cleveland 35, Ohio

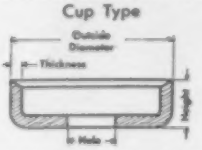
PACIFIC SALES DIVISION
15844 Strathern St., Van Nuys, Calif.

PAGE LEATHER PACKINGS ARE MADE SPECIFICALLY TO WORK PROPERLY IN YOUR APPLICATION!

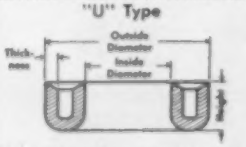
"V" Type



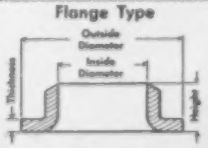
Cup Type



"U" Type



Flange Type



PAGE has at their disposal a number of leather tannages as well as a wide variety of impregnations or coatings. The right combination of these leathers and treatments can be utilized to best suit your needs for leather packings. There are many advantages of leather packings over other types.

Advantages of Leather

- Lower coefficient of friction.
- Will not readily cold flow.
- Low in first cost.
- Suitable for wide range of pressures.
- Will not score or abrade.
- Adaptable to wider range of oil types.
- Permits greater metal clearances.
- Can be stored indefinitely.
- Is not affected by sub-zero temperatures.

If it is our opinion that your packing problem can not best be solved with leather—we will be the first to tell you.

PAGE BELTING CO.
CONCORD, NEW HAMPSHIRE

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FORUM

usually determines the physical size and shape of the machine. And when the space allotted for a particular machine or unit is critical, then the component size is a difficult problem for the designer.

And as for standardization, interchangeability of components, coupled with accessibility for maintenance, greatly affects downtime, and reduced downtime saves money.

K. HILGEFORT
Design Engineer
Sidney Elevator Mfg. Co.
Sidney, Ohio

Our customers have been requiring increased capacities for some of the equipment we furnish. So we have been going to larger cylinders and higher speeds. These require higher pressures to operate properly. We have been running into problems with hose for higher pressures and radiation.

I would like to see pilot-operated, solenoid valves that can be detached more easily from a manifold than present ones.

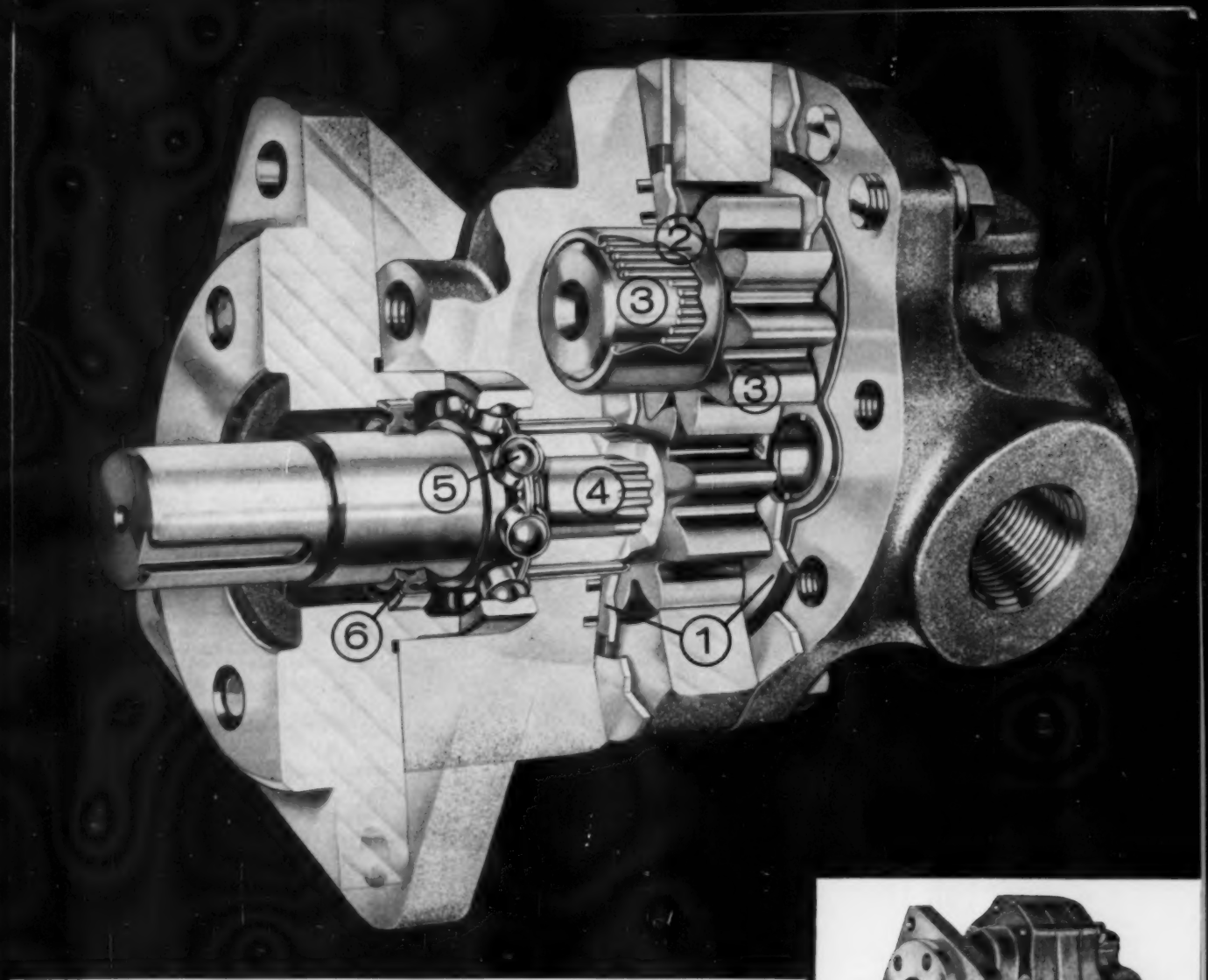
R. SHUSTRIN
Senior Engineer
AMF Atomics
Greenwich, Conn.

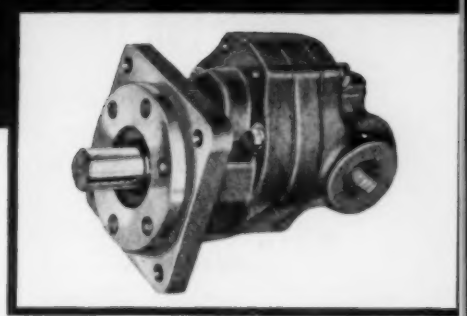
• ***What is the ideal pressure for your equipment? Could you benefit from higher pressure components? What kind of equipment do you design?***

All major hydraulic problems from 50 mines, mills, and factories are routed through our office. We find that destructive shock in high pressure (5000-psi) systems requires custom built equipment. Off-the-shelf items, other than pumps, are difficult to find in larger sizes. To give the designers an advantage in selling the idea of higher pressure to operating and maintenance people, equipment should be rated in terms of hours, temperature cycles, continuous cycles, continuous or intermittent duty, etc.

Continued on page 32

Circle 180 →





Here's how **WEBSTER** *puts new efficiency in hydraulic power*

We cut this new JE series pump in half to show you why Webster design tops competition in overall efficiency. Specifically, the JE saves horsepower, slashes operating costs, delivers dependable and trouble-free service.

It's the result of this combination of advanced features.... (1) pressure-balanced wear plates for high volumetric efficiency and to prevent clearance changes due to heat; (2) needle bearings for power-saving, anti-friction operation; (3) one piece gear and bearing journal units to assure minimum deflection and proper alignment on both drive and idler assembly; (4) free-floating internal spline drives to eliminate key failures; (5) thrust bearing on drive shaft to absorb compound driving thrusts; (6) double lip seal on drive shaft for added protection against seal failure and dirt.

The Webster JE series pump is a heavy-duty, big power unit built to meet the needs of the mobile industry. It is trim and compact to fit into tight quarters, attaches with a choice of mountings. Your Webster Electric representative has complete specifications and data — or write direct for engineering detailed sheet HYl-l.

JE SERIES PUMPS

Shaft seal: double lip type
Drive: direct, gear or belt
Capacity: 10 sizes — 5 to 40 gpm
Pressures: to 2000 psi
Operating Speeds: to 2400 rpm
Porting: side (std.) end (opt.)
Mounting: SAE Type A (std.)

OIL HYDRAULICS DIVISION
WEBSTER ELECTRIC
RACINE · WIS

Franklin adv. H130

HIGH TORQUE at SLOW SPEED

Patent No. 2,821,171

New Char-Lynn Hydraulic ORBIT MOTORS® deliver Full Torque regardless of speed range

Even under normally critical conditions involving low RPM, Char-Lynn ORBIT MOTORS maintain maximum efficiency . . . and because these ORBIT MOTORS function as both a fluid displacement motor and gear reducer, no speed reduction devices are required.

Char-Lynn ORBIT MOTORS make possible unlimited hydraulic design opportunities for constant and variable speed drives, hydrostatic transmissions and remote controls.

- Speeds from 10—800 RPM
- Pressures to 2000 PSI
- Torques to 3000 lb. in.

WRITE TODAY FOR COMPLETE INFORMATION

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FORUM

In my opinion, the big field for industrial hydraulics is hydraulic motor applications. Rotary power requirements are usually met with electric motors. The maximum practical flux density corresponds to approximately 200-psi compared to 2000-psi in a hydraulic motor. This comparison shows the advantage of hydraulics.

When we base our future designs on hydraulics, servo systems will follow. This will upgrade hydraulic engineering and reflect favorably the success of this industry.

S. G. TANSEY
Hydraulic Designer
General Engineering Office
Johns Manville Corp.
Manville, New Jersey

Pneumatic ground test rigs for aircraft servicing and military use, generally use pressures up to 4500 psi. There are some needs for air or nitrogen at 6000 psi, but these are limited.

Normal maximum hydraulic pressure with tractors and agricultural equipment is 2500 psi. In the machine tool field, 500 psi is more normal.

Aircraft pneumatic systems use air tapped from the turbine compressor, where high air pressure is required. This is normally stored at 3000 psi, and the maximum pressure generally employed is 4500 psi.

J. F. JAMES
Senior Project Engineer—
Industrial
The Hymatic Engineering Co., Ltd.
Redditch, Worcestershire
England

My studies of our application show that higher pressures are desirable. But since we do not manufacture hydraulic equipment, we are confined to the pressures suggested by the manufacturers. Our application is industrial, and it is used to drive a reactor control rod.

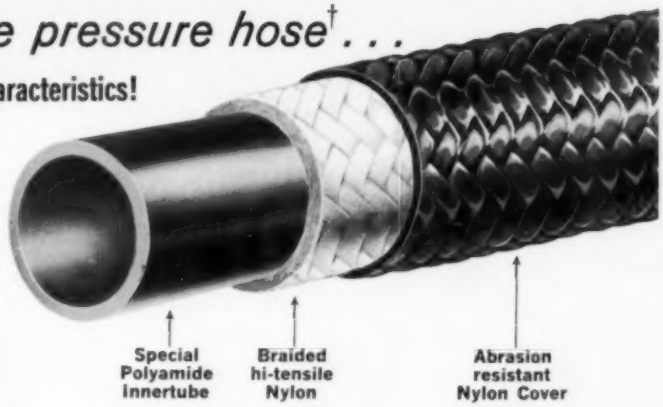
RICHARD E. BRANDT
Mechanical Engineer
General Atomic Corp.
San Diego, Calif.

Continued on page 35

NYLAFLOW® *flexible pressure hose†. . .*

a new all nylon product with new performance characteristics!

Standard and pre-formed assemblies of NYLAFLOW pressure hose.



NYLAFLOW hose features an all-bonded construction in which the braid is chemically bonded to the innercore and the abrasion resistant nylon cover is chemically bonded to the braid. Compared to unbonded construction this important feature allows the hose to be bent to a considerably tighter radius before kinking occurs. When the kinking force is removed, NYLAFLOW hose snaps back to its original shape. Kinking does not seriously affect the burst strength of this all-bonded product.

NYLAFLOW PRESSURE HOSE brings new performance and cost advantages to such applications as : hydraulic lines • high pressure lubrication and pneumatic lines • fuel and oil lines • solvent or hot paint lines • freon lines • high pressure CO_2 or oxygen lines • anhydrous ammonia lines.

PERFORMANCE ADVANTAGES

physical

• high pressure rating with small O.D. to I.D. ratio (wall thickness approximately 45% that of rubber hose with equivalent burst strength) • excellent resistance to fatigue when flexed and pressure pulsed • light weight—approximately 1/5 the weight of equivalent rubber hose • fluids show less pressure drop due to smooth, low surface friction innercore • mechanically strong—resists abrasion and impact • maintains tight fittings even at elevated temperatures.

chemical

• will not swell or degrade in presence of almost all hydraulic fluids, greases, oils, solvents and alkalis • low freon permeability compared to other non-metallics—less than 1/10 that of rubber hose • odorless, non-corrosive, fungus resistant • will not embrittle or deteriorate in storage under normal atmospheric conditions.

thermal

• operates in constant exposure to temperatures as high as 225°F. and intermittently in temperatures to 300°F. • retains flexibility and toughness at temperatures as low as —40°F.

electrical

• excellent non-conductor for use around high voltage power lines • can be made conductive for uses such as airless paint spray lines.

fittings and assemblies

• NYLAFLOW hose can be furnished in long continuous lengths (150 to 500 feet) or can be supplied in assemblies with reusable or permanent fittings • NYLAFLOW hose is unique in that it can be permanently formed to small stress free bend radii which improves its appearance and reduces length of hose assembly. It is form stable and will not sag or fall into surrounding equipment.

If you have a specific application in mind or require further technical information on NYLAFLOW hose, fittings or assemblies, write to The Polymer Corporation of Pennsylvania, 2140 Fairmont Avenue, Reading, Penna.

†Patented

NYLAFLOW HOSE SELECTOR

PART NO.	INSIDE DIA. (IN.)	OUTSIDE DIA. (IN.)	MINIMUM BURST (PSI)	RECOMMENDED WORK. PRES. (PSI)	LENGTH CHANGE @ 3000 PSI (%)	MIN. BEND RADIUS (IN.)	WEIGHT (LB./100 FT.)	COIL LENGTH (FT.)
*1203-A	1/16 ±.008	7/32	12,000	3,000	±2	2½	4.3	500
*1104-A	¼ ±.010	23/64	11,000	2,750	±2	2¾	5.0	250
* 906-A	3/8 ±.015	35/64	9,000	2,250	±2	3½	8.3	200
* 808-A	½ ±.018	25/32	8,000	2,000	±2	4½	16.6	200
*6010-A	5/8 ±.022	1 5/16	6,000	1,500	±2	5½	19.3	150
*5012-A	¾ ±.027	1 1/2	5,000	1,250	±2	6½	26.0	150
802-A	1/8 ±.006	15/64	9,000	2,250	±2	1¾	1.6	500
803-A	3/16 ±.008	11/32	9,000	2,250	±2	2¼	2.9	500
804-A	¼ ±.010	29/64	8,500	2,125	±2	2½	4.8	250
504-A	¼ ±.010	13/32	5,000	1,250	±2	2½	3.5	500
506-A	3/8 ±.015	9/16	5,000	1,250	±2	3½	6.6	250
508-A	½ ±.018	11/16	5,000	1,250	±2	4½	10.2	200

The above hose constructions represent present commercial availabilities. Hose of higher burst strengths or special construction can be supplied on request to meet specific requirements. Coil lengths may contain a maximum of two breaks.

• Meet or exceed SAE 100R1 and 100R5 minimum burst values.

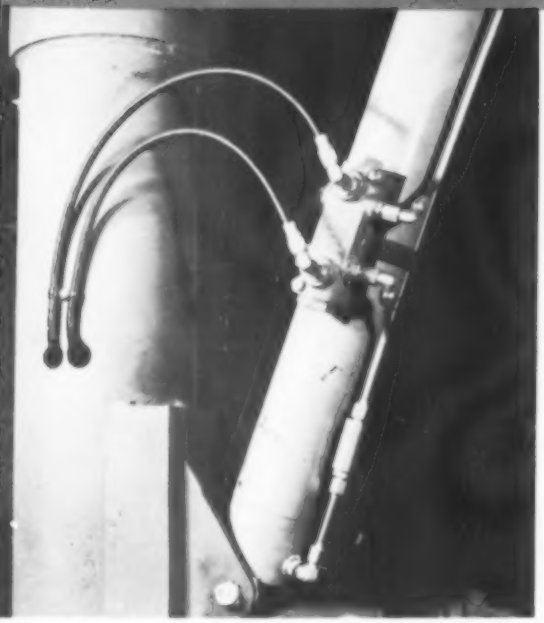
© 1961 The Polymer Corporation

The Polymer Corporation of Penna.
Reading, Pa.

Export: Polypenco, Inc., Reading, Pa., U.S.A.

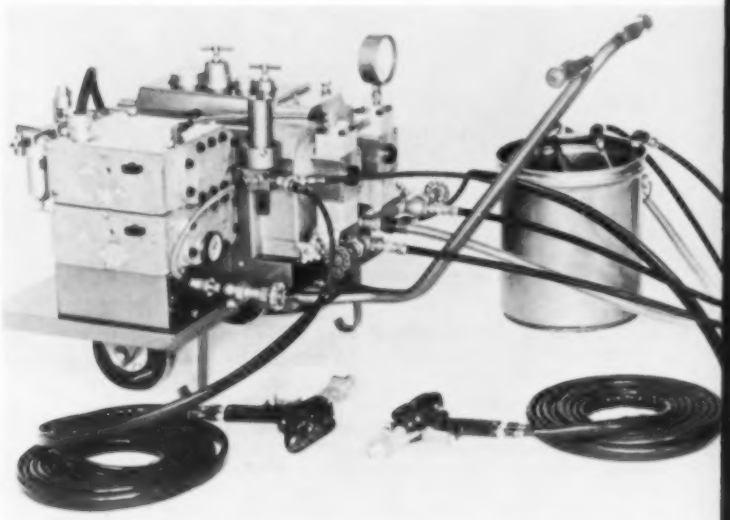
See reverse side for typical applications of NYLAFLOW pressure hose.

POLYPENCO® NYLAFLOW FLEXIBLE PRESSURE HOSE



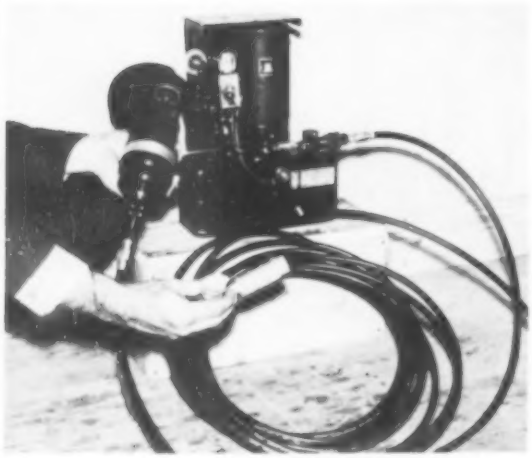
Typical Applications

¼" I.D. NYLAFLOW hose used to power the boom of a utility maintenance truck withstands continuous flexing at pressures as high as 2300 psi, and insulates truck from electrical charges when the boom contacts high voltage power lines. NYLAFLOW hose is considerably less expensive and more compact than special nylon reinforced rubber hose previously used.



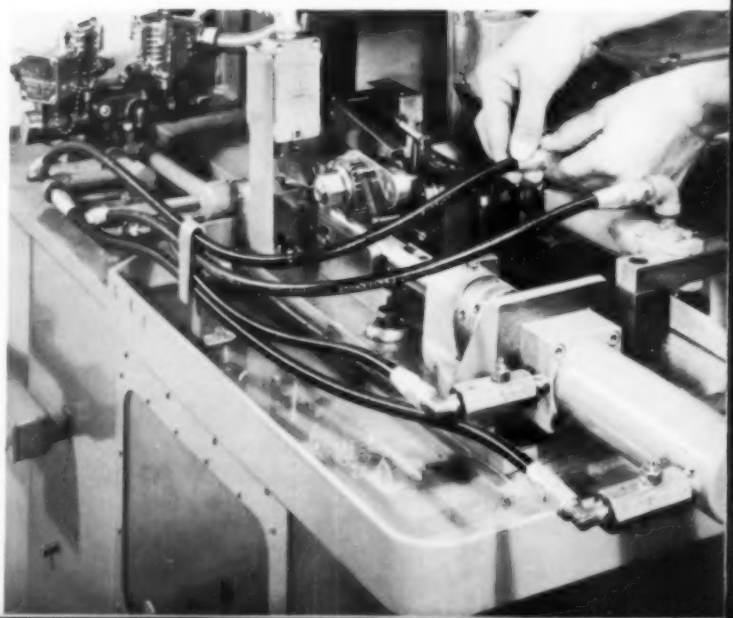
NYLAFLOW hose replaces Teflon* in Airless Spray Coating Equipment reducing hose cost by 70%. NYLAFLOW provides long life when subjected to the chemical action of paints, catalized resins and other materials; temperatures up to 200°F. and pressures up to 1200 psi.

*DuPont Trademark



A special 3/16" I.D. construction of NYLAFLOW hose with a minimum burst strength of 10,000 psi is used on a hydraulically operated compression tool used to attach large fittings to high tension cables. The hose withstands internal pressures up to 5000 psi, is light, easy to handle in field units.

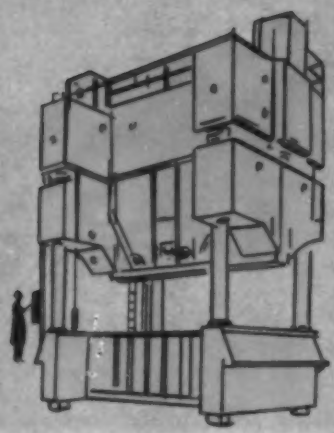
Type 504A, ¼" I.D. NYLAFLOW hose provides long life when flexed 60 times per minute between the solenoid valves and air cylinders of a continuous double and topping machine. Hose is form stable, neat in appearance, eliminates previous problem of breaking fittings from cylinders encountered with lines formerly used.



This information, based on our experience, is in line with accepted engineering practice and is believed to be reliable. However, we do not warrant the conformity of our materials to the listed properties or the suitability of our materials for a particular purpose. This publication is not to be taken as a license to operate under, or a recommendation to infringe any existing patents.

WATERMAN

SPECIALISTS IN HYDRAULIC COMPONENTS FOR INDUSTRY

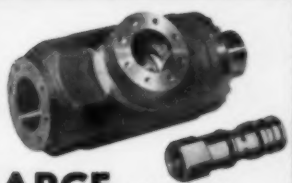


STATIONARY OR MOBILE

TO BRING YOU THE BEST IN PERFORMANCE AT MODERATE COST

The proven performance of Waterman components is demonstrated every day in all types of high-pressure hydraulically operated equipment . . . .

- MATERIAL HANDLING
- EARTH MOVING
- FARM MACHINERY
- MACHINE TOOLS
- PRESSES AND SHEARS
- MISSILE LAUNCHING
- ELEVATORS, LIFTS AND HOISTING EQUIPMENT
- DUMP AND UTILITY TRUCK BODIES
- BOX-MAKING AND PACKAGING MACHINERY
- CENTRALIZED LUBRICATION SYSTEMS
- GROUND SUPPORT EQUIPMENT
- AIRCRAFT



LARGE OR SMALL

WITH PIPE, TUBE, OR SPECIAL PORTS

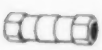
HIGH PRESSURE OR LOW

AUTOMATICALLY OR ELECTRICALLY ACTUATED

FLOW REGULATORS

SOLENOID VALVES

FILTERS

CHECK VALVES 

THE REVERSE SIDE SHOWS SOME OF THESE TYPICAL HIGH PRESSURE COMPONENTS.

WATERMAN HYDRAULICS CORPORATION

REPRESENTATIVES IN ALL PRINCIPAL CITIES

MEMBER NFPA

Mail this convenient postage-free card for additional information and representative's name and address.

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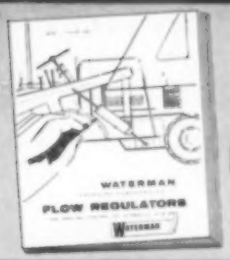
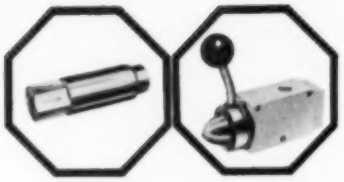
WATERMAN HYDRAULIC COMPONENTS SIMPLIFY SYSTEM DESIGN . . . IMPROVE PERFORMANCE . . . CUT COSTS!

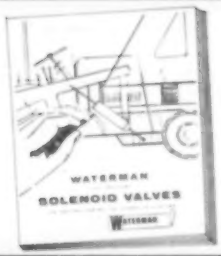


FLOW REGULATORS

FIXED
AND
ADJUSTABLE



190 SERIES FIXED — 1407 SERIES FULL RANGE — ADJ.



SOLENOID VALVES

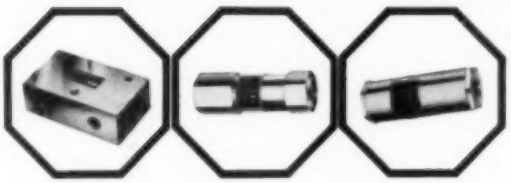
2-WAY
3-WAY
4-WAY
A.C. D.C.

474 SERIES — 312 SERIES — 1617 SERIES

ACCESSORY VALVES

THOSE
"ALWAYS NEEDED"
ITEMS

UNLOADING VALVES
RELIEF VALVES
COUNTERBALANCE VALVES
HYDRAULIC FUSES



271 SERIES — 345 SERIES — 481 SERIES

Though the standard components in these catalogs most often will serve your hydraulic needs, we also design and manufacture special or combination units.

If you are an original equipment manufacturer of production products, contact us. Our specialized engineering and production capabilities can be of benefit to you.

Approved Source for "AN" & "MS" Qualified Flow Regulators and Hydraulic Fuses

I WANT TO SEE THE BENEFITS OF WATERMAN VALVES.

SEND CATALOG CHECKED

FLOW REGULATORS ☐

SOLENOID VALVES ☐

ACCESSORY VALVES ☐

COMPANY_____

STREET_____

CITY_____ ZONE____ STATE_____

SIGNED_____ TITLE_____ HP

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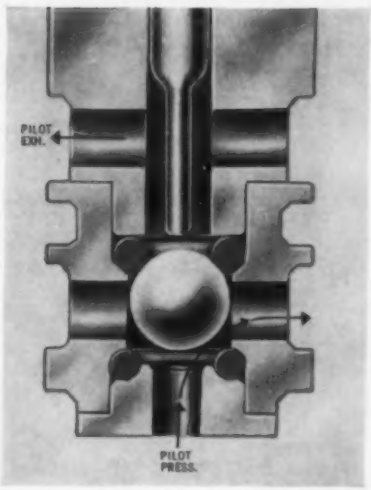
725 CUSTER AVENUE
EVANSTON, ILLINOIS
TELEPHONES
(CHICAGO) BRoadway 3-2262
(EVANSTON) GReenleaf 5-7945
TELETYPE EVST 3597-U

How To Build An Air Valve That Beats Friction and Coil Heat



ENLARGED SECTION OF PILOT CARTRIDGE

To Achieve Endurance, a Breakthrough in Speed

Generally, the most unpredictable factor in solenoid valve life is the solenoid coil itself, and yet, a solenoid can be made to last practically forever if the coil can be kept from overheating. Coil heat is generated by long plunger travel and accelerated by erratic drag (friction) during that travel. Achieve a short, quick, sure plunger stroke and the coil will last indefinitely. Therefore, the life of a solenoid pilot air valve is directly related to speed of operation. To achieve operating speed, friction in the pilot section and solenoid plunger travel must be reduced to a minimum. Solve these problems and you get air control reliability that seems to have no limit.

The Call-Outs Tell the Story of Endurance

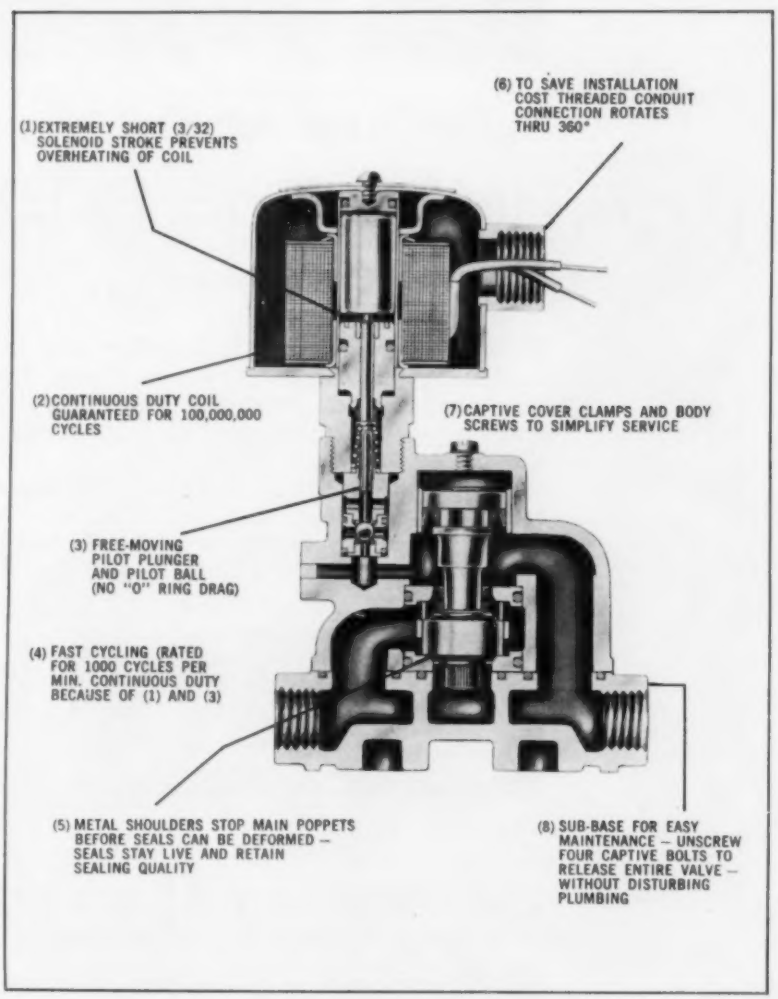
To control the major source of coil burnout, coil heating, the stroke of the solenoid plunger must be reduced to a minimum. The short stroke fractions the time the coil is energized; heat generation drops and response time of the valve is stepped up. In the "Mach 2" the stroke has been reduced to 3/32—about the thickness of a nickel. Furthermore, the friction problem must be solved, to avoid any unpredictable drag. In the "Mach 2" this has been done by use of a pilot cartridge enclosing a free-moving ball that seats on "O" rings at both ends of the cartridge [see above]. The ball moves freely, independent of the seals. There is no "O" ring drag on the pilot plunger as it requires no seals. When there is no friction there is no wear. Similarly, the main valve seats seal on "O" rings. In the sealed position, metal shoulders take the shock in such a way that the "O" ring seal is merely kissed by the main valve seat [see (5) below]. As the rings are only minutely flexed they do not fatigue or lose their resilience.

What about Cycling Speed?

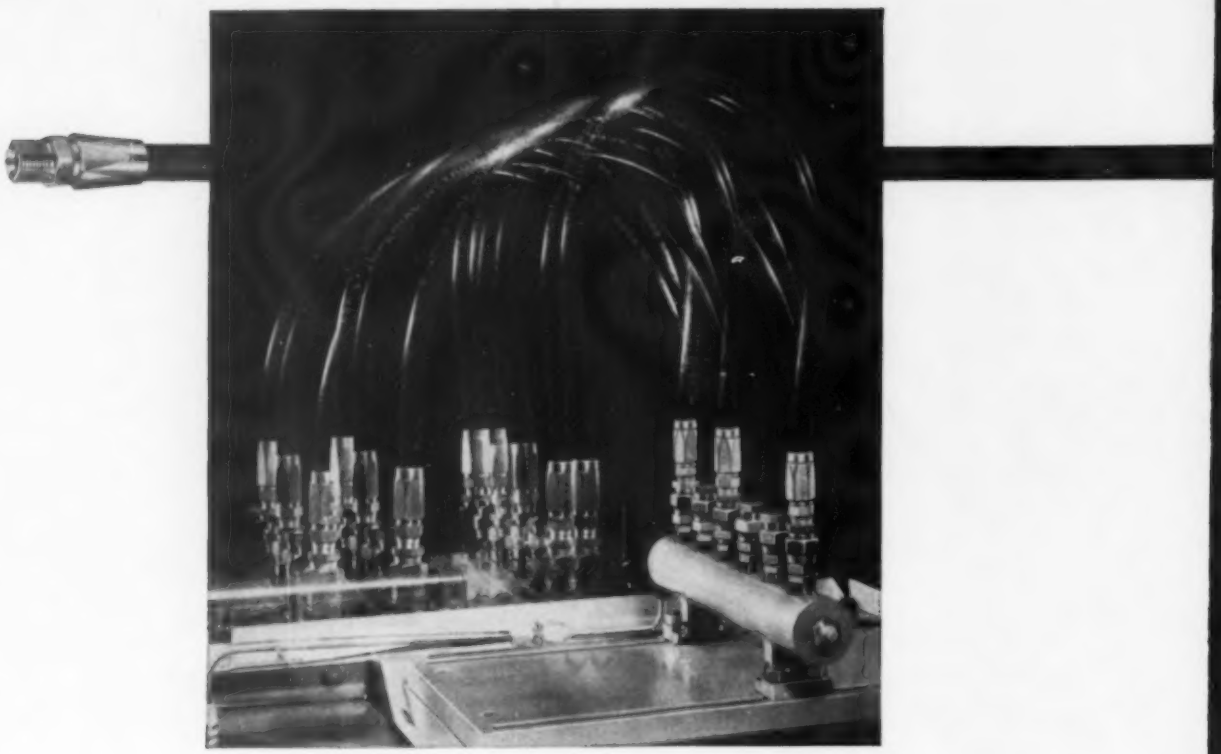
Short solenoid plunger stroke and elimination of friction make extremely fast cycling feasible. After exhaustive testing in the laboratory and on industrial applications for over six years the "Mach 2" is rated at 1000 cycles per minute continuous duty. Cycling speeds as high as 2100 have been successfully reached for intermittent periods of twenty minutes. During a two-hour test at a sustained speed of over 1500 cycles per minute the coil temperature stabilized at 7°C below the maximum code limit for Class A coils.

100-Million-Cycle Guarantee on Solenoid Coils

The design advances incorporated in the CRESCENT® "Mach 2" Air Valve are a significant breakthrough in both cycling speed and operating dependability. Put CRESCENT® "Mach 2's" (¼- to ¾-inch pipe sizes) on your "valve killer" jobs and see how freedom from coil burnout helps to cut operating costs. Write for an advance copy of the new CRESCENT® "Mach 2" catalog to Barksdale Valves, 5125 Alcoa Avenue, Los Angeles 58, Calif.


(1) EXTREMELY SHORT (3/32) SOLENOID STROKE PREVENTS OVERHEATING OF COIL
(2) CONTINUOUS DUTY COIL GUARANTEED FOR 100,000,000 CYCLES
(3) FREE-MOVING PILOT PLUNGER AND PILOT BALL (NO "O" RING DRAG)
(4) FAST CYCLING (RATED FOR 1000 CYCLES PER MIN. CONTINUOUS DUTY BECAUSE OF (1) AND (3)
(5) METAL SHOULDERS STOP MAIN POPPETS BEFORE SEALS CAN BE DEFORMED — SEALS STAY LIVE AND RETAIN SEALING QUALITY
(6) TO SAVE INSTALLATION COST THREADED CONDUIT CONNECTION ROTATES THRU 360°
(7) CAPTIVE COVER CLAMPS AND BODY SCREWS TO SIMPLIFY SERVICE
(8) SUB-BASE FOR EASY MAINTENANCE — UNSCREW FOUR CAPTIVE BOLTS TO RELEASE ENTIRE VALVE — WITHOUT DISTURBING PLUMBING

Circle **25** on Reader Service Card



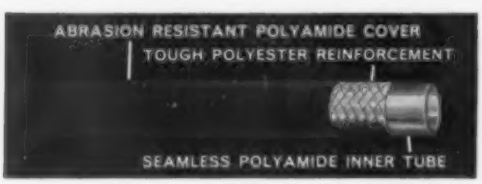
Hytron® hose delivers

7 TIMES THE FLEX LIFE

of wire braid hose

No need to pamper Hytron Hose. It lasts long, saves money on many applications. Hytron also has a wider range of uses than wire braid hose because it is more compatible to different fluids—mineral or synthetic fluids having a water or phosphate ester base.

Extra-long flex life and compatibility are *only two* of the outstanding advantages of Hytron Hose. For more information, see the next page. And write for detailed report and test results—Bulletin NEPR-500.



HYTRON

IMPERIAL EASTMAN

Imperial-Eastman Corporation General Offices: 6300 West Howard Street, Chicago 48, Illinois

Imperial-Eastman Corporation (Canada) Ltd., Barrie, Ontario • Imperial-Eastman, S.A., Apartado Postal 26544, Mexico 13, D.F.

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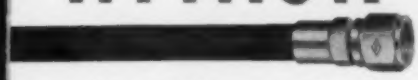
HYTRON



solves problems, meets more needs, cuts costs

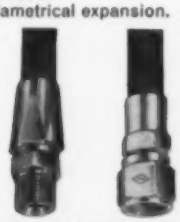
Hytron Hose, made with a seamless, extruded inner tube of special virgin polyamide, has a high-tensile-strength polyester braid reinforcement, plus extruded polyamide cover. Its strength compares with wire braid hose—its *additional* features open new design opportunities in hydraulic and pneumatic systems.

Compatibility=more uses

Hytron Hose is compatible with mineral or synthetic fluids having either water or phosphate ester base. Thus, you can use this *one* hose for *more* applications. Wherever you use S.A.E. 100R1 wire braid hose, Hytron should be considered.

Major advantages

- 7.2 times the flex life of wire braid hose.
- 2½ times more abrasion-resistance than rubber. High resistance to mildew, heat, sunlight, chemicals.
- Burst pressures from 9000 to 12,000 psi, depending on hose size and temperature. Temperature ranges from −40° to 250° F.
- Available in long lengths—up to 1000 ft. Sizes to ¾ in.
- 60% lighter weight than wire braid rubber hose.
- Low diametrical expansion.



Hytron Hose furnished as factory-made assemblies with permanently attached couplings, or with easy-to-install, re-usable couplings, in a wide range of sizes and styles.

HOSE

IMPERIAL — EASTMAN

FORUM

The ideal pressure with gear type oil pumps is 100 kg/sq cm (1420 psi). If possible I want 150 kg/sq cm (2130 psi). It brings great benefit. We use hydraulic equipment for fork lift trucks, shovel loaders, and auger machines which are products of our company.

T. YAMADA
Chief Engineer
Nippon Yusoki Co., Ltd.
Kyoto Fu, Japan

We find most systems working at 1000 psi or under. This is true, we believe, because 1000-psi pumps have been well merchandized through the years. Now engineers automatically size their cylinders to use that type pump. Also engineers are more than a little concerned about going to higher pressures because of line and component breakage due to faulty hook-ups, etc. This is further abetted by the price of higher pressure pumps.

We believe that higher pressures and smaller cylinders will have to be merchandized and engineers educated in the same manner as with 1000-psi systems.

Some 5000-psi systems are used, but they still are rare.

JOE WESSELS
Engineer
Depatie Fluid Power Co., Inc.
Kalamazoo, Mich.

Our equipment consists of mobile motor-pump units, and is used in the oil fields for fracturing and well servicing. Pressure ranges from 300 to 2000 psi on our equipment. The majority of hydraulic applications are for control rather than lifting and carrying devices. At the present time higher pressures are not required. We may shortly have some questions on cold weather operation of low pressure hydraulics.

R. D. MCLEOD
Design Engineer
Eskimo Fracturing & Well Servicing, Ltd.
Edmonton, Alberta, Canada

OIL LEVEL GAUGES

Flush Mounting • Direct Reading • Heavy Pattern

For Hydraulic and Lubricating Oil Reservoirs

Type 550
Available in 3 standard production sizes with 4", 6" and 8" long sight openings

Models Suitable For
- Petroleum Products
- Phosphate Esters
- Glycol-Water Solutions
- Oil-Water Emulsions
- Other Special Applications

For complete information write:
FEDERAL BRASS MANUFACTURING COMPANY, Elmira 2, New York

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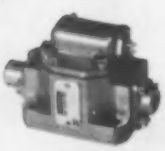
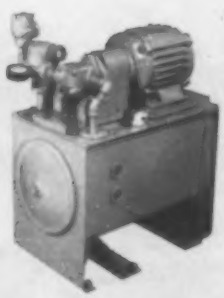
THESE VICKERS COMPONENTS ARE INCLUDED IN THE ELOX SYSTEM

HYDRAULIC CYLINDERS—Low frictional drag and dependable operation of the 3-inch bore, 12-inch stroke cylinders makes them ideal for the Elox machine shown. Vickers builds a complete line of cylinders and offers a wide choice of mounting options, rod end threads, wrench flats, port positions and connections. Standard bore sizes range from 1½" to 8" with either standard or heavy duty rods; special designs can be provided to suit every application. For more details ask for Bulletin 60-68.



SERVO VALVES—Extremely critical requirements for low deadband and high response for instantaneous reversals to clear the electrode dictated the selection of a Vickers servo valve for the Elox spark discharge machine. Three series of Vickers servo valves are available to meet every type of industrial application: a single stage valve rated at 0-3 gpm and two series of 2-stage servo valves for flows of 0-17 gpm and 0-37 gpm. For more details ask for Bulletins 59-74, 61-79.



POWER PACKAGE—The standard Vickers T-10 power package supplies the steady pressure required for optimum operation of the Elox electrical discharge machine. A vane pump and relief valve matched to the system plus the basic tank unit constitute the power package. Vickers builds the most complete range of power packages available anywhere—all components "matched" in output to insure optimum performance and reliability. For more data on how these power packages can simplify your design and procurement problems, contact your Vickers Application Engineer.

Don't Miss Booth 549
Design Engineering Show
Detroit, May 22-25

VICKERS®

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
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FUTURE EVENTS

NFPA SPRING MEETING

May 14-17

The Greenbrier
White Sulphur Springs, W. Va.

FLUID CONTROLS INSTITUTE MEETING

May 21-23

Sea Island
Georgia

ASME DESIGN ENGINEERING CONFERENCE & SHOW

May 22-25

Cobo Hall
Detroit

ASTME ENGINEERING CONFERENCE & TOOL EXPOSITION

May 22-26

New York Coliseum

HYDRAULIC FLUIDS SEMINAR

May 23

Allen-Bradley Hall of Science
Milwaukee School of Engineering
For registration information, contact M. E. Striegel, Director, MSOE Evening Div.

ASME SUMMER ANNUAL MEETING

June 11-15

Statler Hilton Hotel
Los Angeles

HYDRAULICS COURSE

June 12-13
Illinois Institute of Technology, 3300 S. Federal St., Chicago 16. Contact D. W. Prosser, Oil Hydraulics Laboratory for details. (See page 74 for course outline.)

WESTERN PLANT MAINTENANCE SHOW

July 18-20

Pan Pacific Auditorium
Los Angeles

NATIONAL CONFERENCE ON INDUSTRIAL HYDRAULICS

October 19-20

Sherman Hotel
Chicago

NFPA FALL MEETING

October 24-26

Sheraton Hotel
Philadelphia

Circle 176 →

ROBERT WEBB, RESEARCH DIRECTOR, ELOX CORPORATION SAYS:

"Jointly developed hydraulic system provides fast response needed for spark machining..."

"When people have a problem that can be solved with three-dimensional electric discharge machining, they come to Elox for our special skills and knowledge. Similarly, we insure that our machines offer the last word in performance by working as a team with components and systems manufacturers.

"To produce cavity dies like the one shown above, we designed and built a machine with a precision table and a vertical slide accuracy that we can guarantee within .0005" to 12 inches. We were able to develop a hydraulic circuit for the vertical slide and get a faster response than with any other method because Vickers engineers understood our problems thoroughly and cooperated fully in effecting their solution.

"Speed of response is half the story; the other is precise maintenance of the spark gap without 'hunting'—enabling the spark machining operation to be completed in the shortest possible cycle. Our hydraulic package meets all the foregoing requirements because the individual units are matched to each other and to the machine itself."

The Elox experience is typical of Vickers assistance to machinery builders and/or users in providing outstanding hydraulic equipment or systems to insure peak performance. Specialists working with the broadest line of top quality hydraulic components available anywhere give you a system ideally suited to your specific needs. See facing page for more details about the hydraulic components used by Elox and the entire Vickers line.

VICKERS®

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
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9640

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FILTERS
AND
STRAINERS
FOR
40 YEARS

New Low Price

. . . NEW DESIGN

The economy of this all-new design by Dollinger makes Staynew Sump Filters a must for the protection of hydraulically-operated equipment.

- **Molded leak-proof end seals of special plastic are completely impervious to all synthetics, and mineral-base oils.**
- **Exclusive Radial Fin Design offers maximum filtering area in any given space. Mesh filtering medium supplied in 60 or 100 screen.**
- **One-piece construction makes the filter easier to handle and install. The stocking of spare parts is eliminated.**

Dollinger Sump Filters can be installed in eight standard sizes with capacities from 5 to 100 GPM. For larger capacities, multiple filters may be used. Consult your telephone directory for the nearest Dollinger representative, or write us direct for Bulletin 330-H. Dollinger Corporation, O.E.M. Division, 65 Centre Park, Rochester 3, New York.

STAYNEW FILTERS

DOLLINGER

FELT DRY-TYPE AIR CLEANERS FOR INTERNAL COMBUSTION ENGINES • LIQUID FILTERS AND STRAINERS FOR FUEL, LUBE OILS AND HYDRAULIC SYSTEMS • FELT DRY-TYPE COMPRESSOR INTAKE FILTERS

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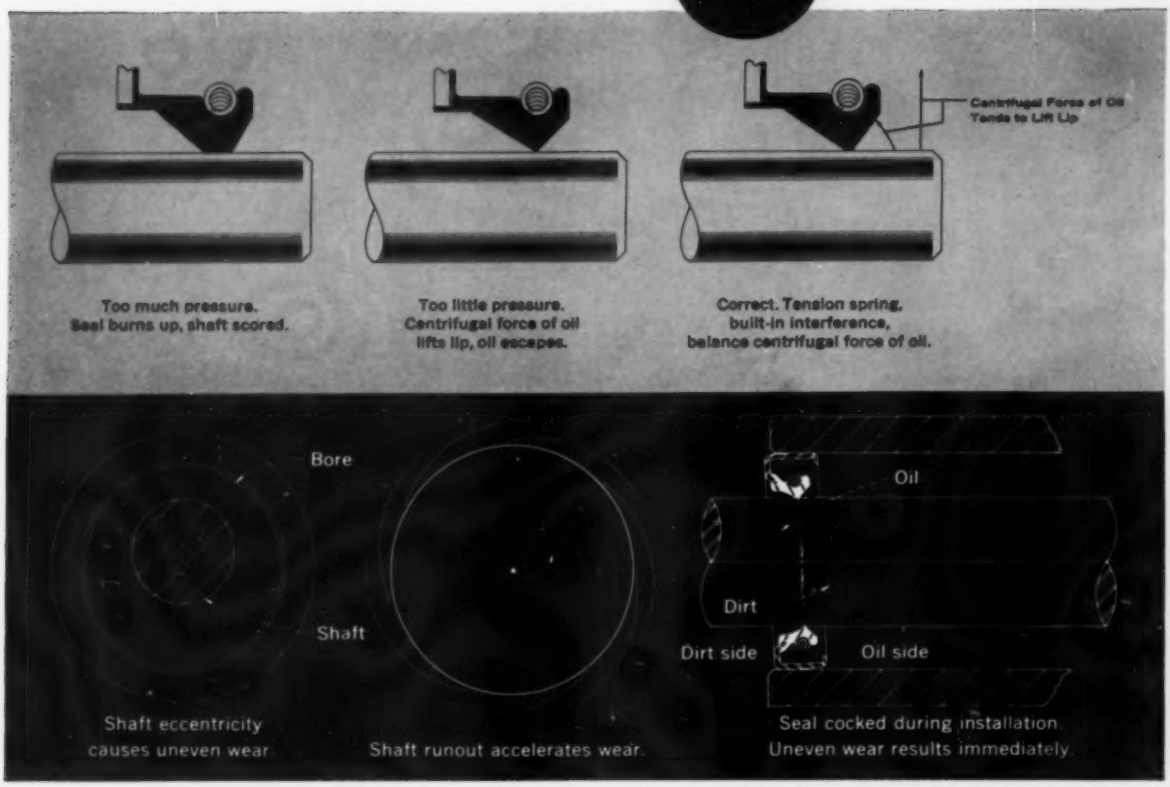
Lip pressure...too much or too little, and you've a leaker for sure!


Centrifugal Force of Oil Tends to Lift Lip
Too much pressure. Seal burns up, shaft scored.
Too little pressure. Centrifugal force of oil lifts lip, oil escapes.
Correct. Tension spring, built-in interference, balance centrifugal force of oil.
Bore
Shaft
Shaft eccentricity causes uneven wear.
Shaft runout accelerates wear.
Oil
Dirt
Dirt side
Oil side
Seal cocked during installation. Uneven wear results immediately.

Ideal sealing conditions are (1) shaft in bore center, (2) no runout, (3) seal not cocked, (4) seal concentric, (5) bore round and smooth, (6) shaft round and properly finished, (7) seal proper size.

Meeting these conditions is complicated, frequently requires special seal design or the specialized knowledge of National Seal engineers.

Sealing problems should be anticipated and answered on the board, not in production. Why not call your National Seal engineer now about your current project. He's in the Yellow Pages, under Oil Seals or O-Rings.

NATIONAL SEAL
Division, Federal-Mogul-Bower Bearings, Inc.
GENERAL OFFICES: Redwood City, California
PLANTS: Van Wert, Ohio; Redwood City and Downey, California

6860

NOW **PARKER** HAS ELIMINATED A MORE SERIOUS ANNOYANCE ...LOST TUBE FITTING FERRULES!

A simple change in the design of Parker "Intru-lok®," the positive, bite-type Parker fitting for copper, aluminum or plastic tubing, has solved an age-old problem.

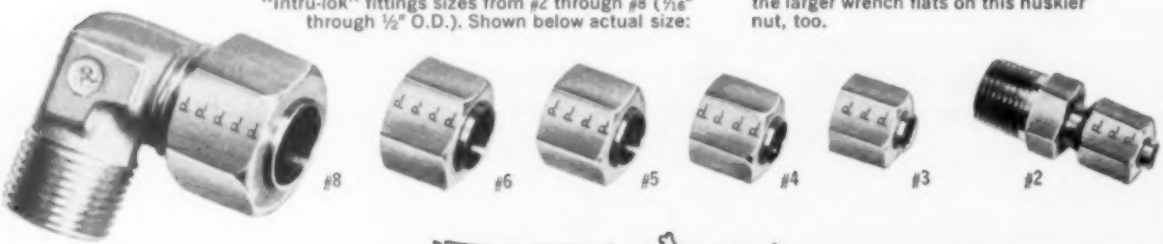
Small three- and four-piece tube fittings have long been a pain in the neck on applications where it is necessary to remove the nut from the fitting. The ferrule(s) fall out and promptly disappear. If and when found, they often get put in backwards. Sometimes they never get put back at all. Result, in either case: a leaking joint.

Now Parker has developed a snap-in, captive ferrule for "Intru-lok." You can take it out of the nut, "on purpose," but you can't drop it out accidentally.

You get all the leakproof safety of a three-piece fitting with positive "bite." You also get the convenience, the quick, easy assembly of a two-piece fitting. The easiest fitting to install has been made even easier. Write for new "Intru-lok" dimensions and prices today.

Three "detents" hold the "tail" of the new ferrule in the nut. Also, the larger hole in the nut makes tube bends closer to the fitting possible. Note the larger wrench flats on this huskier nut, too.

The new nut with captive ferrule is available on all "Intru-lok" fittings sizes from #2 through #8 (1/16" through ½" O.D.). Shown below actual size:



PARKER HANNIFIN CORPORATION

Parker FITTINGS AND HOSE DIVISION

17325 Euclid Avenue • Cleveland 12, Ohio

PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS

8279-P11

EUROPEAN DIVISION • PARKER-HANNIFIN N.V. • SCHIPHOL • THE NETHERLANDS

Circle **133** on Reader Service Card

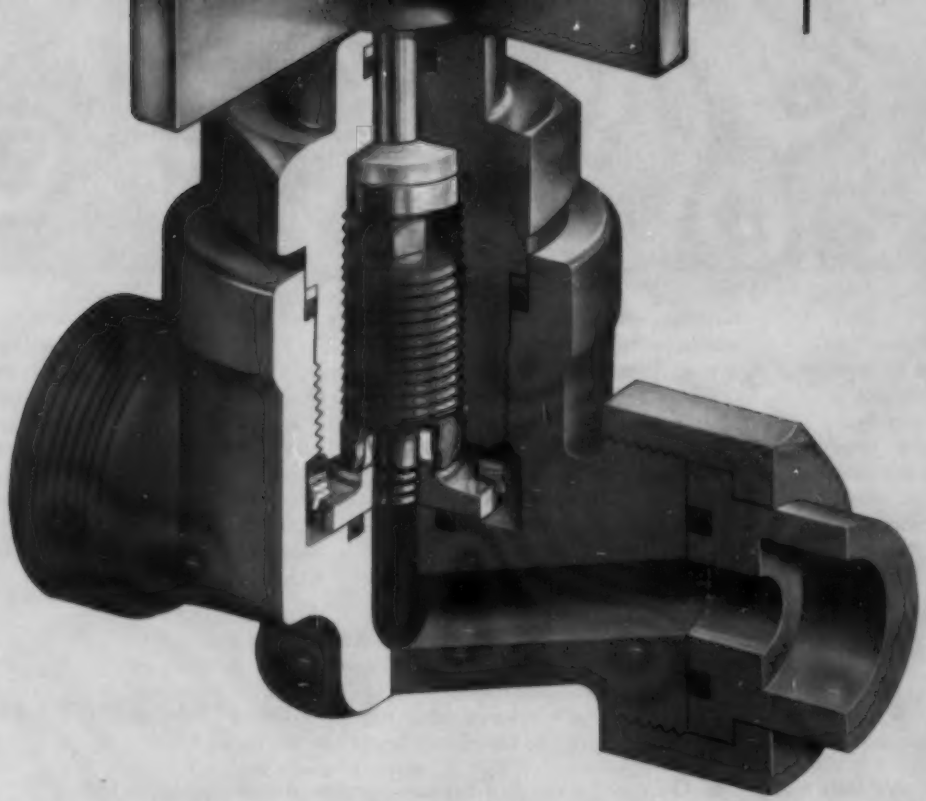
Circle **45** →

PV

O-SEAL SYSTEM

for high pressures

"Bubble-Tight" at 6000 psi . . . Proved by the Nuclear Subs . . . Handtight Connections



THIS HIGH PRESSURE SYSTEM HAS MADE ALL OTHERS OBSOLETE!

And for good reason. Leakage can't be tolerated when line pressure soars to 6000 psi. The CPV O-SEAL SYSTEM not only satisfies this critical requirement, but provides a degree of design flexibility previously unavailable even for low pressure applications.

Leakproof connections are made – or broken–at will, and they remain leakproof regardless of vibration or line surge. CPV design employs O-rings as static seals that *use* line pressure to effect a perfect seal. In fact, the higher the pressure, the tighter the seal.

Valve packings, a constant source of maintenance, have been completely eliminated.

"Bubble-tight" valve shut-off is assured every time by combining a resilient nylon disc with a monel valve seat.

The reliability of CPV soft-seated valves and the effectiveness of O-ring sealing have been proven by certified government tests. In one of these, a CPV O-SEAL valve showed no sign of leakage at over 4000 psi after more than 4500 successive closures!

Also, the CPV O-SEAL SYSTEM is so flexible that you can assemble, remove, relocate or modify any section or the complete system without springing or cutting the lines.

Turn the page for more details on this proven breakthrough in high pressure system design . . .

See the CPV O-Seal System in action at the Design Engineering Show — Booth 805

DESIGN SHOW

DETROIT • MAY 22-25

TOOL EXPOSITION

Hydraulics & Pneumatics

SPECIAL REPORT

O-SEAL SYSTEM
for high pressures

"Bubble-Tight" at 6000 psi . . . Proved by the Nuclear Subs . . . Handtight Connections

Here's the business end of a CPV O-SEAL valve under test in a 6000 psi line. The thin film of soap solution covering the discharge port proves there isn't any leakage through the valve seat. Unique nylon disc and monel seat design combine to give "bubble-tight" valve shut-off of water, oil and any gas — even "hard to handle" helium.

Ever since the USS George Washington left the drawing boards, the O-SEAL SYSTEM has been specified for handling the critical high pressures on nuclear submarines. This, and a rapidly growing roster of industrial applications, underlines the basic soundness and proven reliability of this unique system for line pressures to 6000 psi.

Just tighten the union nut *by hand* and you have a connection that will be leakproof well above 6000 psi. Even after installation, valve can be repositioned or removed merely by loosening the union nuts. Same principle applies to unions, elbows, tees, and fittings. Unlimited flexibility is assured without sacrificing leak-tight requirements.

A Complete System for 1500 or 6000 psi Service

CPV offers a complete system of O-SEAL valves and fittings to meet a wide range of high pressure design needs at fluid temperatures from −20° to 275°F. Unions, elbows, tees and fittings in addition to globe, check and relief valves are available in sizes ranging from ⅛-inch to 2 inches. Two complete series—for working pressures to 1500 psi or to 6000 psi—provide unequalled design flexibility.

Details and specifications on the full line of CPV O-SEAL valves and fittings are given in 36-page Catalog 60-A. Clip the coupon below to your company letterhead and mail to CPV today for your copy.

Combination Pump Valve Company
846 Preston Street, Philadelphia 4, Pa.

Please send me Catalog 60-A on the CPV O-SEAL SYSTEM

Name_____

Title_____

Firm_____

Address_____

City_____ State_____

COMBINATION PUMP VALVE COMPANY

See the CPV O-Seal System in Action at the Design Engineering Show—Booth 805

DESIGN SHOW

DETROIT • MAY 22-25

TOOL EXPOSITION

NEW YORK • MAY 22-26

Hydraulics & Pneumatics

SPECIAL REPORT

FLUID POWER COMPONENTS

. . . how far have we come?

. . . where are we going?

As thousands of visitors study products shown at the Design Engineering Show in Detroit and the Tool Exposition in New York this month, the big question will be, "What can they do for me?" They'll be seeing the latest developments, many of them for fluid power systems. They'll be evaluating these products for application on their equipment.

Two factors are basic in product development—*need* and *capability*. These factors are very much at work in the development of hydraulic and pneumatic components that make up fluid power systems. Presented in the following pages and in next month's issue are both sides of the coin—requirements of machine builders for components to meet present and future needs; and products available now, and in the works.

To gather this information, H & P editors surveyed the fluid power component manufacturers to find out what's newest, what are the unique design features, how do these fill a need. Of course no survey like this could be complete, but these representative developments show how component manufacturers are keeping up (and sometimes ahead) of industry's needs. More information on 1960's new products is given in the *Fluid Power Products Review* (H & P Jan. '61).

THE ROAD AHEAD

Two important growth areas for fluid power in the months and years to come are numerically controlled servo systems and hydrostatic transmissions. Components for both of these are developing fast—to get better performance at lower cost—because the applications promise to be almost limitless.

At least a dozen companies are working on hydrostatic transmissions, mostly for vehicle traction drives where the high volume production is so tempting. Theoretically, h-s transmissions are the perfect drives for materials handling and earthmoving vehicles which travel at moderate speeds, require high starting torque, short turning radius and benefit from hydraulics' infinite speed control. Cost is the main reason that h-s transmissions haven't caught on. But improved manufacturing methods are hacking away at the cost problem, and the major breakthrough

Exhibitors at the

DESIGN SHOW MAY 22-25 COBO HALL • DETROIT

TOOL EXPOSITION MAY 22-26 COLISEUM • NEW YORK

PUMPS, COMPRESSORS, DRIVES

DESIGN SHOW

945 Louis Allis Co.
921 Century Electric Co.
836 De Laval Steam Turbine
1228 Diamond Chain Co., Inc.
423 General Electric Co.
129 Leiman Bros., Inc.
1044 Lovejoy Flexible Coupling
1203 Owatonna Tool Co.
544 Parker-Hannifin Corp.
744 Reliance Electric & Engrg.
1149 Robbins & Myers, Inc.
119 Roper Hydraulics, Inc.
508 U. S. Electrical Motors Inc.
549 Vickers Inc.
356 Westinghouse Electric
501 Wooster Div., Borg-Warner Corp.
308 Worthington Corp.

TOOL EXPOSITION

1414 Bendix Corp.
1315 Brown & Sharpe Mfg. Co.
1011 Davey Compressor Co.
2633 Denison Engrg. Div.
2222 Do All Co.

FILTERS, FLUIDS, AIR LINE CONTROLS

DESIGN SHOW

160 Air-Maze Corp.
214 Commercial Filters Corp.
1120 Hilliard Corp.
920 E. F. Houghton & Co.
910 C. A. Norgren Co.
544 Parker-Hannifin Corp.
642 A. Schrader's Son Div.
1117 Screen Products, Inc.
107 Wilkerson Corp.

TOOL EXPOSITION

2517 Bellows-Valvair, Div. IBEC
2433 Gulf Oil Corp.
2028 E. F. Houghton & Co.
3418 Mobil Oil Co.
1521 A. Schrader's Son Div.
3917 Stewart-Warner Corp., Alemite Div.
4918 Watts Regulator Co.

PLUMBING & SEALS

DESIGN SHOW

953 AFCO Fitting Co.
619 Aeroquip Corp.
131 American Sealants Co.
540 Auburn Mfg. Co.
237 Crane Packing Co.
919 Colonial Rubber Co.
1108 Crawford Fitting Co.
1235 Disogrin Industries
146 Dixon Corp.
763 E. I. du Pont de Nemours
615 Flexonics Corp.
311 Flodar Corp.
618 Garlock Inc.
105 Greene, Tweed & Co.
512 Hansen Mfg. Co.
920 E. F. Houghton & Co.
956 Imperial-Eastman Corp.
742 International Packings
853 L & L Mfg. Co.
626 National Tube Div., U.S. Steel
811 Ohio Seamless Tube Div., Copperweld Steel Co.
1105 Polymer Corp.
918 Raybestos-Manhattan, Inc.
543 Republic Steel Corp.
456 Resistoflex Corp.
104 Rotherm Engrg. Co., Inc.
937 Russell, Burdsall & Ward Bolt and Nut Co.
1058 Sealol Inc.
1029 Snap-Tite, Inc.
815 Standard Pressed Steel Co.
106 Stratoflex Inc.
849 Superior Tube Co.
801 Titeflex Inc.
762 U. S. Rubber Co.
626 U. S. Steel Corp.
1259 Weatherhead Co.

TOOL EXPOSITION

2221 Flick-Reedy Corp.
2028 E. F. Hougton & Co.
2302 Standard Pressed Steel Co.
3917 Stewart-Warner Corp., Alemite Div.

CYLINDERS, ROTARY ACTUATORS

DESIGN SHOW

1155 Airmatic Valve, Inc.
1005 Carter Controls, Inc.
1013 Clippard Instrument Laboratory, Inc.
829 Mo-Bar Hydraulics Co.
626 National Tube Div., U. S. Steel
1203 Owatonna Tool Co.
544 Parker-Hannifin Corp.
543 Republic Steel Corp.

405 Sandusky Foundry & Machine Co.
642 A. Schrader's Son Div.
962 Thomson Industries, Inc.
549 Vickers Inc.

TOOL EXPOSITION

2517 Bellows-Valvair, Div. IBEC
2221 Flick-Reedy Corp.
1325 Logansport Machine Co.
1521 A. Schrader's Son Div.

VALVES, GAUGES, CONTROLS

DESIGN SHOW

1155 Airmatic Valve, Inc.
825 Automatic Switch Co.
1200 Chemiquip Co.
805 Combination Pump Valve
1014 Eagle Signal Corp.
224 Fawick Airflex Div.
1024 General Controls Co.
455 Hoke Inc.
1154 Humphrey Products Div., General Gas Light Co.
839 Mead Specialties Co.
209 Nuclear Products Co.
1202 OPW-Jordan Corp.
544 Parker-Hannifin Corp.
223 Robertshaw-Fulton Controls Co., Acro Div.
709 Ross Operating Valve Co.
642 A. Schrader's Son Div.
900 Skinner Electric Valve Div.
857 U. S. Gauge Div.
1243 Valcor Engrg. Corp.
549 Vickers Inc.
1259 Weatherhead Co.
501 Wooster Div., Borg-Warner Corp.

TOOL EXPOSITION

2517 Bellows-Valvair, Div. IBEC
1315 Brown & Sharpe Mfg. Co.
2633 Denison Engrg. Div.,
2222 Do All Co.
1325 Logansport Machine Co.
2454 Mechanical Air Controls
1521 A. Schrader's Son Div.

1253 (Design Show) HYDRAULICS & PNEUMATICS

is now in sight. Not that h-s transmissions are still in the experimental stage. They're being used on earthmoving, mining, farming, and handling equipment. (H & P Dec. '56, Mar. '59). They're also giving advantages in production operations like rollover inspection, and turn-around fixtures. Spindle drives (H & P Feb. '61) are profiting from constant horsepower characteristics of h-s transmission.

Among the manufacturers concentrating on h-s transmissions, the New York Air Brake Company's Watertown Div. has recently announced that it is producing its *Dynapower* transmission for mobile equipment. A package system of the split type, the basic transmission has a variable displacement, axial piston pump and an axial piston motor. Other combinations can be made for various applications. Denison Engineering, Sundstrand Hydraulics, Dynex, and Racine Hydraulics have been active in applying hydrostatic transmissions on mobile equipment. In the works at Vickers are developments for high performance transmissions of both the integral (pump and motor in one package) and split designs.

Fluid power's glamour is in its servo systems. Already at work on a number of machine tools, hydraulically powered servo systems spur the imagination of any designer looking for better ways. The process industries—petroleum, chemical, pharmaceutical, food—will all benefit more and more from programmed control with fluid power actuation. A single helicopter may someday control a battery of harvesting combines; earthmoving machines may be tape controlled to contour a roadway. Higher flows and horsepower ratings are in the picture too as shown by Oilgear's new 250 gpm valve for 3000 psi. Measuring 24" x 12" x 14", the valve weighs 500 lb. One application is for screwdown power cylinders of a steel plate, cold mill.

Servovalve manufacturers find themselves sandwiched between electronic control requirements on one side and hydraulic actuation requirements on the other. At this stage, many manufacturers like Denison Engineering Division believe the way to success is to take on the whole servo system, electronics and hydraulics. That establishes one responsibility for the many components that must work together in closest harmony.

Again in servo systems, the demon cost has to be overcome. One weapon (which is now competitive with programmed servo-systems) may prove to be a blessing in disguise. Control systems which eliminate servovalves are developing. Using a fast approach, slow down, and stop sequence, they can give .0002 inch accuracy at lower cost than more complex servo systems.

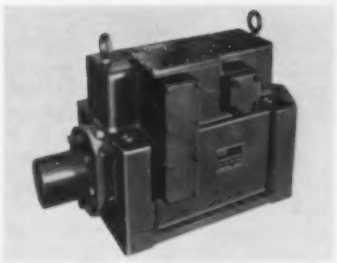
These may be the key to introducing sophisticated control to more applications. Then in time, when requirements are pushed still further, systems incorporating servovalves will find a waiting market. ■

PUMPS, ACCUMULATORS, COMPRESSORS, DRIVES

To meet industrial requirements for higher pressures and efficiencies Webster Electric has brought out their new axial piston motors and pumps in sizes from .72 to 1.81 cu. in./rev. Continuous pressure rating is 3000 psi and maximum operating speed is 2400 rpm. Design objectives in these pump/motor units have been simplicity and easy servicing. The pistons and piston barrel can be serviced without removing the front half of the pump from the circuit. The unit can be disassembled and rotation reversed in the field. It can also be used as a dual rotation motor. The unit is compact enough that SAE A type mounting can be used with access to both mounting holes.

• **Higher Volumes, Pressures**—Industrial requirements for high volume pumps have led Texas Hydraulics to introduce its 200-gpm

(at 900 rpm, 3000 psi) radial piston pump. It is variable and reversible with stem, handwheel, servo, reversing, and compensator controls. Among the pump's design features are built-in valves in each piston. These insure positive lubrication between piston and cross head. The company also has a new high torque, low speed fluid motor in development. Its operation is based on a rotary distributor valve which is installed between two double acting cylinders. Multiple banks of two additional cylinders increase torque.



SERVOVALVE CONTROLLED PUMP can deliver from either port with over-center slide block design. Maximum flow can be reversed at speeds to 0.1 sec. Sizes range from 13 to 169 gpm for 1350 psi, 5 to 108 gpm for 2050 and 3000 psi. The Oilgear Co.

2500-PSI GEAR PUMP has specially designed bearings to take unbalanced loads. Wear plates are compensated for different speeds and pressures. Special O-ring seal was developed for the pump. Parker-Hannifin Corp.

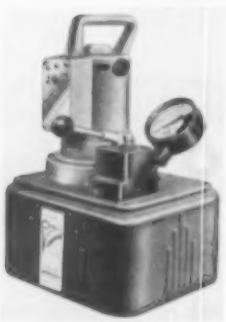
• **Servo Control**—A recent announcement from Oilgear is their new DV, 2-way, variable displacement pumps with servovalve operated strokers. An electrical input signal of 5 watts or less can vary pump output from either port. Maximum flow of large pumps can be reversed at speeds to 0.1 sec., or timed acceleration rates up to 3 minutes or longer can be provided. An integral, linear variable differential transformer provides feedback. A fail-safe device moves the pump to neutral if power fails. Compensation for slip as pressure rises is easily applied. The servo controlled pumps are especially efficient for applications requiring 5 hp or more.

DESIGN SHOW

508 U.S. Electrical Motors, Inc.

You'll see . . . Controlled speed system for accurate coordination of conveyor complex or wherever synchronous transfer is required. Uses a-c motors. Also stable a-c system for tension control by speed trimming of individual drives. For textiles, plastic laminations, wire, and strip metal processing.

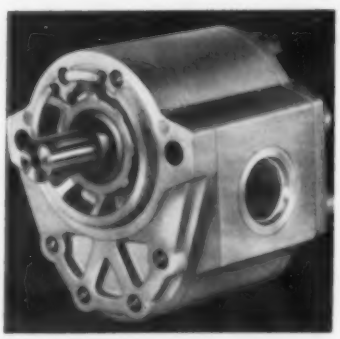
Circle **200** on Reader Service Card



1203 Owatonna Tool Co.

You'll see . . . Two-stage hydraulic pump. Consists of gear pump for low-pressure stage. Five-cylinder axial-piston pump, supercharged by gear pump, for high-pressure stage. Delivers 600 cu. in./minute at 100 psi, 50 cu. in./minute at 10,000 psi. Overall size 10¾" x 12⅝" x 17½". Reservoir capacity 2-gal, 1¼ gal usable oil.

Circle **201** on Reader Service Card



501 Wooster Div., Borg-Warner Corp.

You'll see . . . Hydraulic gear pumps. Standard SAE mounting and drive shafts. Interchangeable, tin-aluminum alloy bearings. Aluminum body. Double lip shaft seal. Capacities from 8 to 21 gpm. Speeds to 3000 rpm. Pressure, 2000 psi. Displacements from 1.0 to 2.7 cu. in.

Circle **202** on Reader Service Card

1044 Lovejoy Flexible Coupling Co.

You'll see . . . flexible couplings which install easily, using only a straight edge to align. Never need lubrication. No adjustments or maintenance. Not affected by contaminants. Horsepower ratings from 1/20 to 8500. From solid to 9½" bore sizes. Spider-type cushions used in couplings rated from 1/20 to 40 hp, 1750 rpm. Individual load cushions in couplings from 2.6 to 950 hp, 100 rpm.

Circle **203** on Reader Service Card

549 Vickers, Inc.

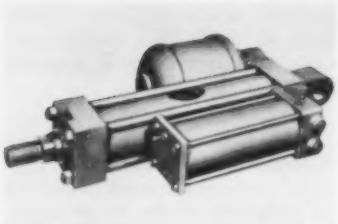
You'll see . . . in-line piston pumps (shown). Ratings 5 and 10 gpm, 1800 rpm. Fixed or variable displacement. Pressures to 1500 psi continuous, 3000 psi intermittent. Also single stage servovalve. Rated 3 gpm with 350-psi pressure drop. Torque motor activates spool directly. 90-deg phase shift at 200 cps. Miniature directional control valves for jig positioning and clamping, hydraulic gear shifting and clutching on machine tools, and venting of hydraulic system

relief valves. To 1000 psi, 2 gpm. 4-way, single and double solenoid. 4-hp variable speed hydraulic drive. Motor has six mounting positions. Varying pump displacement controls hydraulic motor. Close coupling of electric motor and hydraulic pump. No-load maximum speed 1800 rpm.

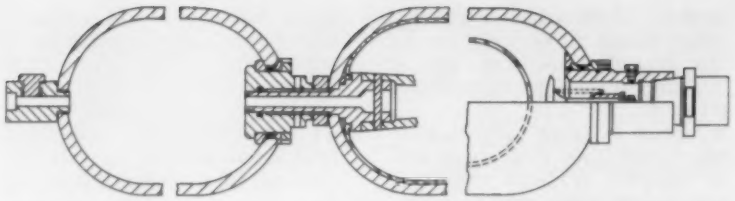
Circle **204** on Reader Service Card

129 Leiman Bros., Inc.

You'll see . . . Integral pump and motor unit. Vacuum to 27" hg. Pressure to 15



CYLINDER-PUMP-VALVE UNIT contains all components for hydraulic actuation. All that's required is to connect motor wiring through a reversing switch to an electrical power source. The Sheffer Corp.



PIGGY BACK ACCUMULATOR is bladder type with additional gas storage in the auxiliary bottle. Greer Hydraulics, Inc.

• **Better Bearings, Longer Life**—In pumps designed primarily for farm equipment, life is not a major factor because hydraulic systems have to operate only a small part of the total life of the machine. The machine has to be replaced long before the hydraulic components wear out. But on heavy earthmoving equipment that is expensive to buy and expensive to operate, the emphasis is on operating without breakdowns.

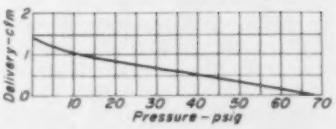
In Parker-Hannifin's 2500-psi, 2500-rpm gear pump, the accent has been on bearing design. Wear plates are pressure loaded according to gear-side pressure. This required compensating at different speeds and pressures. Delivery ranges to 160 gpm.

Dynex has completed development on new 45- and 90-hp axial piston pumps and motors, fixed and variable delivery. The new variable delivery pump features an eccentric cam which rotates in response to the pump control and operates poppet valves that bypass fluid from the discharge side back to the inlet. Bearing loads are in proportion to the work being done.

A new entry in the hand pump field is Brand Hydraulic's double acting pump which supplies .3 cu. in. of oil on both the push and pull stroke. It is rated at 3000 psi and has a built-in relief valve.

A packaged power unit that has been brought out by Sheffer incorporates a cylinder, as well as pump, reservoir, motor, and circuit block. The cylinder can have a variety of bore and rod sizes to meet specific force requirements. Circuit blocks which incorporate the valving can be selected for locking, differential flow, or a combination. Reversing the motor retracts the cylinder. The *Powr-Pak* has been used to raise and lower flood gates, and to operate large plug valves on overhead pipelines.

Two new reciprocating plunger pumps for water hydraulic service have been made available by Worthington. These triplex pumps have strokes of 2" and 6" for 15 and 160-hp inputs. A feature of the larger pump is that stuffing boxes may be removed through liquid cylinder heads and repacked on a work bench. Both pumps can be equipped with bolted-on gear reducers for direct coupling to high speed, electric motors. This is particularly important in hazardous locations where belt drives cannot be used. These new horizontal pumps make low-cost installations where there are no high pressure shocks in the system.



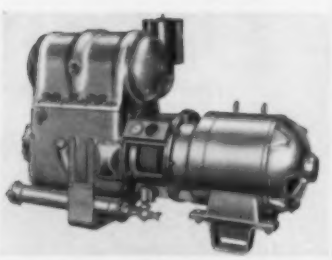
AVERAGE FREE AIR DELIVERY of 1/12-hp compact compressor and vacuum pump. Bell & Gossett Co.

• **More Accumulator Capacity**—Among accumulator developments are a new piggy-back bladder type and a new piston type, both from Greer Hydraulics. The bladder type has advantages of fast response, non-contamination of fluid, and minimum leakage. It also offers maximum oil volume, and pressure differential detection on the gas side. It has built-in storage for additional gas volume. The accumulator, which has ASME approval, is for 3000-psi working

psig. Displacement of 12 cfm. Accessories include inlet air filter, automatic oil lubricator, outlet oil vapor-silencer. Measures 22½" x 12" x 9½".

Circle **205** on Reader Service Card

TOOL EXPOSITION



1011 Davey Compressor Co.

You'll see . . . Rotary air compressors. Designed for plant air service. Oil cooled. 100-hp, 476-cfm unit.

Circle **206** on Reader Service Card

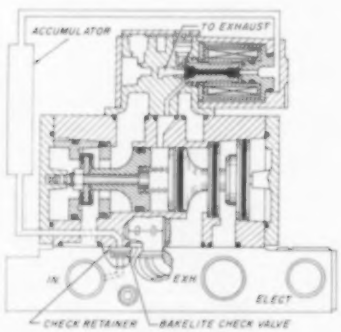
pressure, 12,000-psi burst. The 20-gallon piston accumulator has T-ring dynamic seals. It is rated at 3000-psi working pressure, 9000-psi burst.

• **Midget to Giant Compressors**—New compressors range from Bell & Gossett's 1/12-hp compressor and vacuum pump to Fuller's two-stage compressor with deliveries to 3300 cfm. The Bell & Gossett model is available in two types: one with 1.9-cfm displacement for operation to 27" vacuum, and the other with 1.43 cfm displacement for 65-psi operation. The compact (5" wide, 8⅝" high, 8⅝" long) units have a clearance factor between piston and cylinder head which eliminates the need for a safety valve.

Fuller's new multivane, rotary compressors were designed for simple installation. They have overhead inter-coolers for compactness, and can be installed either on a floor or mezzanine. The compressors have capacity ranges from 279 to 3300 cfm with discharge pressures to 125 psi. Cylinders are water jacketed. Intake and discharge openings are on a horizontal plane on opposite sides of the cylinder to avoid flow reversal and simplify piping. ■

VALVES, GAUGES, CONTROLS

Pilot-operated valves usually depend on line pressure for shifting, so many poppet valves are sensitive to restrictions in supply or exhaust, because their pilot supply "feels" supply pressure changes as the valve shifts. Parker-Hannifin's new *Hustler* valve has an accumulator section which stores compressed air to give a positive shift regardless of line pressure. Stored volume, which is held by a plastic check valve, is four to five times that required to shift the valve.



BUILT-IN ACCUMULATOR between plastic check valve and pilot section stores air volume for fast valve operation at low line pressure. Parker-Hannifin Corp.

• **Encapsulated Coil**—For longer solenoid life, the valve has a plug-in nylon covered coil. This encapsulation keeps out moisture and forms a close bond between nylon and copper windings for good heat dissipation. The coil's inside surface forms the bearing for the plunger, giving quiet operation without lubrication. The nylon is color coded according to voltage. Aluminum die cast parts have reduced inertia, so that the coil requires only 7½ watts for operation at 150 psi. The solenoid cover is chained internally for better appearance. Use of die cast parts throughout the valve gives large air passages free from core sand.

The valve seals to its manifold block with five O-rings held together by a thin rubber membrane. This makes installation easy. The membrane gives a water-proof gasket for the electical connection from the base to the main valve body.

Enlarged exhaust ports give the valve fast operation in welders. Free flow in exhaust ports is even more important than in pressure ports because of the reduced pressure to force out air.

Automatic Switch is meeting temperatures, pressure, and fluid requirements with wide use of new materials such as urethane, Thiokol, Butyl, and Hypalon. A normally-open valve for air pressures to 1000 psi will be made available this year. With a-c operation it will also handle water and light oil up to 850 psi. The d-c version will handle these fluids at pressures to 500 psi.

• **Miniaturization**—Small valves will open up applications for solenoid valves where only manual valves could be used before.

The Allied Control miniature valve has a 1/16-inch orifice with metal-to-metal seat. It has a built-in dashpot which is effective over the total length of plunger travel. With oil of 250-SSU viscosity, the valve takes approximately ¼ second to open or close.

• **Faster Maintenance**—Fast servicing and replacement has been an objective of air valve manufacturers who are well aware of the high cost of production downtime. Manifolding and plug-in construction, used by many valve manufacturers, are two recent developments which have speeded valve maintenance. The *PDQ* poppet type valve introduced by Hunt Valve, is removed in half a minute or less by loosening two hold-down bolts, twisting and removing the pilot section, then lifting off the main housing. The poppet of this valve is a one-piece assembly which permits pressurizing and exhausting the cylinder ports alternately,

DESIGN SHOW

455 Hoke, Inc.

You'll see . . . Gauge protector, 1⅞" long. Stops flow to gauge when pressure protection point is reached. Max. setting, 1000 psig. Automatic re-set. Handles inlet pressures to 3000 psig, from —10 to 200 F. Ranges cover 30 to 150, 150 to 500, and 500 to 1000 psig. Inlet and outlet connections ¼" NPT female. For gas service.

Circle **207** on Reader Service Card

1154 Humphrey Products Div., General Gas Light Co.

You'll see . . . complete operating display of ⅛", ¼", and ½" air valves.

but with a simultaneous action rather than the time lag with two separate poppets. The one-piece design has also reduced the size and weight of the poppet and valve. The valve is available in ⅜" or 1" with sub-base, or ½" modular manifold.

Beckett-Harcum has just brought out ⅜-inch direct solenoid actuated valves for manifold mounting. These are for both air and hydraulic media. The company has also added stacking, manifold air valves in ¼, ⅜, and ½-inch sizes with plug-in features, so that no piping or wiring need be disturbed when replacing the valve.

Versa Products' new *Coordinates* use a modular design technique of unit-by-unit expansion. Two-place and three-place mountings are the basic units for building up multi-valve stations. Like many manifold designs, only one

MODULAR DESIGN permits making up many types of air valves from less than 50 standardized units. Hoffman Valves.

inlet is required for the entire block. When a threaded exhaust block is used, only one exhaust connection is needed. Each subplate has locating pins for precision alignment. Adjustable, built-in speed controls are available, and plates with and without speed controls can be intermixed.

Another effort to simplify maintenance and spare parts stocking, has been made by Hoffman Valves with their modular spool valve. Many variations can be made up from less than 50 standardized, interchangeable parts. Each module can be assembled in any one of four positions to accommodate piping.

Air Valves' new solenoid valves have separately mounted, valve and solenoid pilot sections. They are available in single or double (momentary) types. Cycling speeds range to 1000 cycles per minute.

• **Increasing Solenoid Life**—Longer solenoid life with shorter stroke was the objective of Barksdale Valves in designing their *Mach 2* air valve. Biggest factor in solenoid coil life is heating caused by long plunger travel and erratic friction. A short, quick, plunger stroke gives long solenoid

---

Pressures to 125 psi. Square body and round body. 2-, 3-, and 4-way. Cam, pilot, solenoid, and manual actuation. Also cartridge valves (shown). For inside of cylinder.

Circle **208** on Reader Service Card

900 Skinner Electric Valve Div., Skinner Precision Industries

You'll see . . . Sub-miniature solenoid valves. For all common media including

many semi-corrosive fluids. Weighs 5 oz, 1" dia. Orifices 3/64", fluid connections 1/16" NPT. Pressures to 150 psi. 3-way normally closed now available. 3-way normally open, directional control and 2-way NO and NC soon available. Housings have grommet or ¼" NPT conduit.

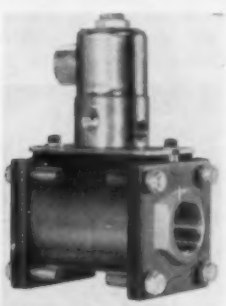
Circle **209** on Reader Service Card

1243 Valcor Engrg. Corp.

You'll see . . . Teflon solenoid valve (shown). Shock and corrosion resistant, pressure proof and chemically inert. For normally closed applications. Also sole-

noid valve to handle radioactive chemicals. For solutions in radiation fields to 25,000,000 rads. For normally closed and normally open applications. Standard ¼" pipe sizes.

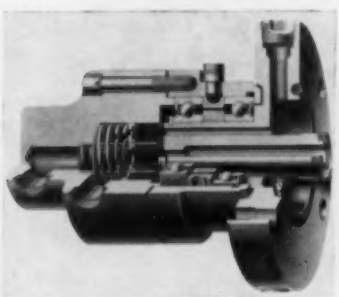
Circle **210** on Reader Service Card



1155 Airmatic Valve, Inc.

You'll see . . . Tube-O-Matic valve. Squeeze action controls air, oil, and chemical flows, without poppets or spools. No metal-to-metal contacts. No metal-to-rubber seals. When open, supply pressure forces rubber sleeve against tube. Media flows around inlet plug and through outlet port. To close valve, pilot pressure is applied between tube I.D. and outside of rubber sleeve. Sleeve collapses over rounded ends of inlet and outlet end plugs, sealing off supply pressure. Pressures to 200 psi. Pipe sizes ¼" to 12". Normally open or closed.

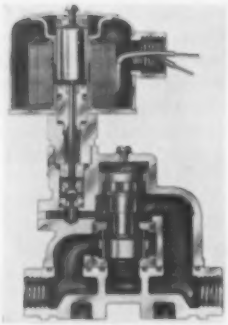
Circle **211** on Reader Service Card



224 Fawick Airflex Div., Fawick Corp.

You'll see . . . single and multiple passage, rotary joints. Transmit air, liquids, or gases under pressure or vacuum from stationary source into a rotating shaft. Positive leak protection with non-metalic sealing ring held against shaft by spring pressure. Single passage unit has pressures to 2000 psi. Speeds to 5000 rpm, either direction. Dual-passage pressures to 150 psi, 3000 rpm. Triple-passage 150 psi, 2000 rpm. Each passage can conduct a different medium. Timing units provide air passage from supply line to pneumatic clutch, and automatically time cycling of machine. Speeds to 500 rpm.

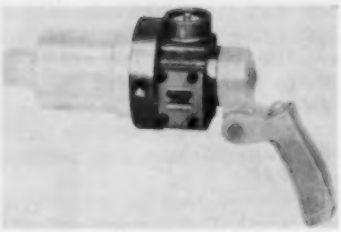
Circle **212** on Reader Service Card



SHORT SOLENOID STROKE of 3/32-inch boosts solenoid life in this air valve. Pilot valve is free floating ball which seats on O-rings. Metal section of main valve limits deformation and fatigue of O-ring seal. Barksdale Valves.

life. Solenoid plunger stroke is 3/32 inch. The pilot valve is a free moving ball that seats on O-rings in both its open and closed positions. Similarly, the main valve seats on O-rings, but metal shoulders take the shock, so that the O-ring seal is only slightly deformed. This reduces fatigue. The valve is rated at 1000 cycles per minute continuous and has cycled as high as 2100 cycles per minute for 20 minutes. During a 2-hour test at over 1500 cycles per minute, coil temperature stabilized at 7 degrees C below the maximum code limit for Class A coils.

In a move to integrate components with the equipment they're installed on, Bellows-Valvair has designed their welding gun valve which manifolds onto a welding gun and becomes an integral part of the tool. Putting the control valve at the point of use saves air volume, compared to a valve mounted at some distance. The valve can be removed by taking out four bolts without disconnecting piping, and it is interchangeable from one gun to another.



WELDING GUN VALVE manifolds to tool. Close coupling makes compact installation, saves air volume. Bellows-Valvair Div.

A recycling poppet valve for actuating directional valves by exhausting static pressure is new from Novi-Matic Valve Div. Pressing the plunger manually or mechanically opens the poppet which reseats when the directional valve is fully exhausted.

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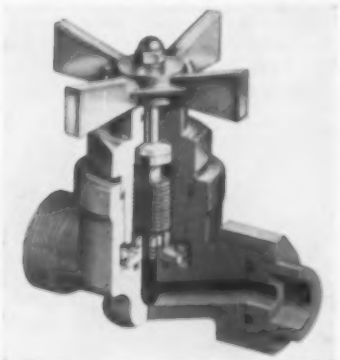
805 Combination Pump Valve Co.

You'll see . . . High pressure valves and fittings. Bubble-tight, shut-off valves to 6000 psi. For water, oil, and gases.

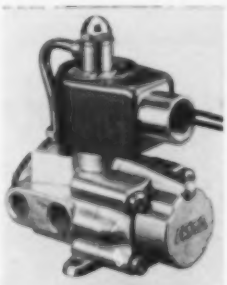


Hand operated. Leakproof bonnet, O-ring sealed. Leakproof end connections to 6000 psi, hand tightened. All valve parts remove as a single unit. Unions, elbows, tees and fittings; and globe, check and relief valves, in sizes from ⅛" to 2".

Circle **213** on Reader Service Card

825 Automatic Switch Co.

You'll see . . . packless solenoid valve. Single solenoid, two position, 4-way valve has ¼" orifices. Forged brass body with ⅜" pipe connections, poppet seats and discs. Main valve discs are power driven in both directions without return springs. Operates on air,



water or oil at pressures to 250 psi, 221 F. Metal-to-metal and resilient tight seating.

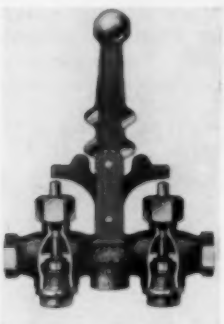
Circle **214** on Reader Service Card

209 Nuclear Products Co.

You'll see . . . Snoop leak detector. Bubbling action detects leaks in pressurized air or gas lines. Solid stream application avoids bubble formation. Will de-

tect leaks at bottom of connections in vertical runs. 8-oz polyethylene squeeze bottle with adjustable tube for hard to reach places. Also micrometer handles which fit all angle and straight pattern valves. Set at zero with valve closed. As valve opens, axial position of stem is read to 1/1000".

Circle **215** on Reader Service Card



1202 OPW-Jordan Corp.

You'll see . . . Aluminum air control valve. For air or hydraulic operation. When lever is moved to right, machine operation is forward. When lever is left, operation is reversed. In center position, machine is inoperative. Hold-open feature locks lever in either position. Self-closing, closes when operator releases lever. Spring loaded poppets. Oversized stems resist bending. Raised seats with in-line disc contact for tight shut-off. Size ½".

Circle **216** on Reader Service Card

1259 Weatherhead Co.

You'll see . . . directional control valves including 2-, 3-, and 4-way rotor-types for oil, water, or air at 5000-psi pres-

• **Higher Pressures**—Unlike the weather that nobody does anything about, there's plenty being done to meet the needs for higher pressure components. Republic Manufacturing, for example, has recently introduced a manual directional valve and a check valve, both rated for 10,000 psi. The directional valve has optically flat seals, and roller thrust bearings that reduce turning torque. Maximum internal leakage at 10,000 psi is 30 cc per minute air, 1 drop per minute water or oil. The check valve has a resilient seal, locked into place between a supporting ring and the valve cap. The valve has a safety factor of 4 and is suitable for high flow, heavy surge conditions.

New slide plate directional valves as well as pressure controls from Dynex are for high pressure applications to 6000 psi and higher.

Also new in the very high pressure range is Robbins Aviation's stainless steel shut-off valve for liquids and gases at pressures to 12,000 psi. No dynamic O-rings are used, all seals are self-energizing. Thirty lb.-in. torque closes the valve against the high pressure. A new, globe type, miniature shut-off valve with body measuring ⅞" square by 1¾" long has a pressure rating of 3500 psi. It offers fine metering control and was especially designed for sampling cylinders.

• **Cartridge Check Valve**—A special, pilot-operated check valve by Universal Hydraulics was designed for installation in a cylinder. The working parts are replaceable as a cartridge. The valve simplifies plumbing.

New developments in flow control valves include pressure—compensated flow dividers and integrators, and needle valves of stainless steel and for higher pressures. Fluid Controls has developed a double flow regulator with detented dial adjustment for use in salt and cinder spreaders where speeds of fluid motors driving auger and spinner must be coordinated. Each half of the double valve regulates up to 15 gpm with pressure compensation. It has an inlet port, two regulated flow ports and a bypass flow port. All ports are on the bottom for easy installation.

A priority type flow divider is new from Fawick Hydraulic-Electronic Div. It permits an operator to select ten calibrated increments of pressure-compensated flow from a constant delivery pump. The valve simplifies control by eliminating a separate selector valve.

Also new is a 4-way, open center, mechanical servovalve. It has no lapped fits, using an O-ring and poppets to seal with no internal leakage. Insensitivity to dirt, and speed of operation at low pump output are features.

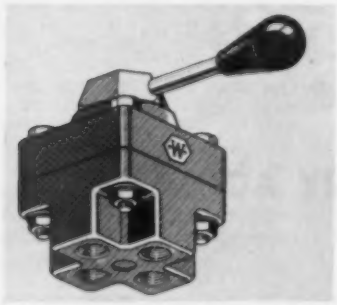
• **Stainless Needle Valve**—New developments in needle valves include Marsh Instrument's stainless steel models with Teflon stem packing. They're suitable for phosphate ester, fire-resistant fluids as well as petroleum base fluids and water. Pressure rating is 6000 psi.

Newest needle valve available from Republic Manufacturing is a soft seat design of stainless steel for panel mounting. The seat is locked in by a metal retainer. Overtightening can't damage it because the metal retainer limits stem movement. O-rings seal the stem and bonnet. Pressure rating is 6000 psi.

Pressure controls which have just come on the market include Fawick Hydraulic-Electronic's cartridge type, pilot operated relief valve which has rapid response, smooth operation, and extremely flat pressure control characteristics. Capacity is 30 gpm to 2500 psi pressure.

Fluid Controls' adjustable, differential unloading valve, sets load and unload pressures independently within a 5% to 20% range. Pilot design insures positive operation without hesitation. Flow rate is 12 gpm. Adjust pressures up to 3000 psi.

Also presented by Fluid Controls during 1960 is a double relief valve with selector, for use



sure. Precise metering of flow from zero to rated capacity. Used for close pressure control. Sizes ¼", ½", and ¾".

Circle **217** on Reader Service Card

TOOL EXPOSITION

2222 DoAll Co.

You'll see . . . 4-way control valve (shown) for hydraulic use. Single and double solenoid or pilot operation. Pressures from 600 to 1000 psi. Precision lapped spools provide blocking action

of valve body parting. Nylon seals. JIC approved. Also package hydraulic system. Pressure, volume and flow direction are controlled. Variable displacement vane pump gives power only as required.

Circle **218** on Reader Service Card

1325 Logansport Machine Co., Inc.

You'll see . . . Dual piston air valves. Cup packing style inner master piston.

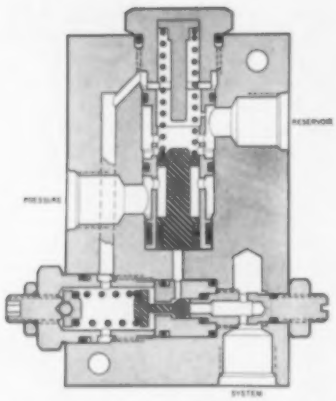
O-ring outer operating piston at each end. Aluminum alloy valve body and covers, with tensile strength of 45,000 psi. O-ring cover seals. Synthetic rubber piston cups. Pressures to 150 psi. JIC standards. All valves counterbored for O-ring.

Circle **219** on Reader Service Card

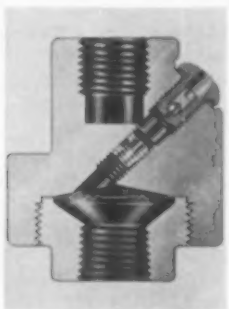
2517 Bellows-Valvair

You'll see . . . Air control valves, air motors, rotary feed and index tables will be shown. Also drill press, grinder and heavy duty power feeds, two lines of air cylinders, timers, and air filter-lubricator-regulator units.

Circle **221** on Reader Service Card



PILOT BALL in this unloading valve allows fluid pressure to shift main spool when system pressure rises or falls to set values. Differential, between loading and unloading pressure, is adjusetd by regulating pilot ball travel between open and closed positions. Fluid Controls, Inc.



PULSATION DAMPENER connects between system line (below) and gauge (above). U. S. Gauge Div., American Machine & Metals, Inc.

with a vented main relief valve in clamping control. System pressure is selected according to allowable clamping force. Tied into an existing circuit, the valve has three positions: one blocks the inlet so that system pressure is limited to setting of the main relief valve, the other two positions select progressively lower preset system pressures. Ranges are 100-800 psi, 250-1500 psi, and 1000-3000 psi.

A pilot-operated sequence valve has been designed by Brand Hydraulics so that when pilot flow has shifted the spool to open it, the spool does not require maintaining pressure to stay open. This a power saving feature, because system pressure only needs to be high enough to move the secondary cylinder without the additional requirement of holding the sequence valve open.

New developments in gauges and accessories make them more versatile and reliable. A temperature–compensated test gauge that maintains a high degree of accuracy through wide temperature ranges is new from U. S. Gauge. Temperature compensation is built into both Bourdon tube and linkage. The tube is made from a high nickel alloy which minimizes the effect of temperature on spring rate. An adjustable link mechanism corrects for zero shift error resulting from expansion and shrinkage of the movement and socket materials.

A new pulsation dampener from U. S. Gauge has a diaphragm of either stainless steel or Neoprene separating the measured fluid from the gauge measuring element. A viscous, non-freezing liquid transmits pressure to the gauge element. An adjustable restriction provides dampening. The dampening chamber above the diaphragm is accessible from the side. It is not necessary to unscrew the gauge to fill the dampening chamber or perform routine maintenance.

Products from Chemiquip promise better instrumentation of fluid power systems. A new diaphragm-sealed pressure-snubber protects a gauge against transient pulsations. It also prevents loss of system fluid in case of gauge rupture.

A one-way snubber which can give either upscale or downscale protection will be brought out soon. Particularly useful for equipment such as injection molding machines and presses, it will have instantaneous response to either increasing or decreasing pressure and will damp the pressure gauge when pressure moves in the opposite direction. It will prevent a lag when fast response is needed, and violent response when damping is required.

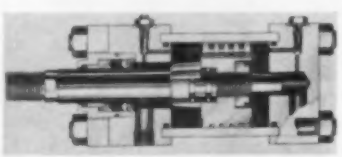
A flow check valve to protect against fluid loss in case of rupture will also be introduced shortly. A slow leak in the valve allows pressure build-up to close the valve when the rupture has been repaired. ■

CYLINDERS, ROTARY ACTUATORS

Teflon piston and rod seals are now a feature of Hydro-Line's new 1" air cylinders. O-rings are used as expanders for the Teflon seals. This design cuts static friction, so that the cylinders start smoothly without a high pressure build-up. The cylinders are especially suited for dry air and high temperature operation. A new standard, rod coupler which allows a .032 radial motion reduces cylinder bearing wear caused by side loads and binding.

Hard chrome plate is now applied to Hydro-Line's air cylinder ID's. It eliminates rusting by air line condensation, and resists scoring to give better internal sealing.

A continuing program at Hydro-Line has been to install Viton rod seals, wipers, and needs seals, in *Series N2* hydraulic cylinders (optional in *Series R2* air and hydraulic cylinders). These seals are used with carbon-impregnated Teflon back-up washers. The combination is compatible with almost all industrial hydraulic fluids and is suitable for higher temperatures than former seals.



CARTRIDGE ROD BEARING complete with metal rod scraper and wiper is removed without disturbing tie rods. Carter Controls.

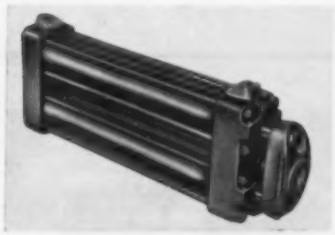
Removal of the complete rod bearing without disturbing tie rods is a new feature made possible by a cartridge rod bearing, complete with metal, rod scraper and rod wiper on Carter Controls' cylinders. The 2000-3000-psi, *Squareline* cylinders also have a floating cushion and a double lock type, piston and rod connection.

Carter will also announce a new, miniature rotary actuator and a heavy duty actuator during 1961.

Both will seal with O-rings and will have heavy bearings for overhung or thrust loads. The miniature actuator will be of a somewhat different design than the company's other rotary actuators. It uses aluminum tubing and heads, and develops up to 200 lb-in. torque.

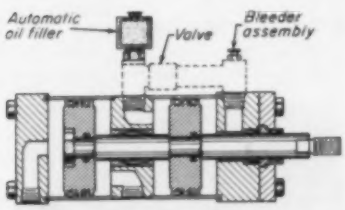
In the high pressure range, Owatonna Tool has introduced double acting cylinders for 10,000 psi. The cylinders have tie-rod construction, are designed primarily for push action, but can also be used for some pull operations.

A twin, center hole cylinder has been announced. An advantage of this design is larger tonnage capacity than a single cylinder of the same length and piston diameter. Another advantage is that the cylinder can be used as a framework against which to pull, for instance in stressing a cable.



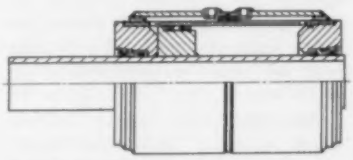
TWIN CYLINDER for 10,000 psi, will be available in bores to 2½". Owatonna Tool Co.

• **Air-Oil Operation**—To combine the speed of air with the control of oil, Lynair has designed their *Airdraulic* cylinder which mounts an air piston and hydraulic piston on the same rod. The two ports of the hydraulic section are connected through an external flow control valve and return check. This arrangement meters flow controlling rod speed.



AIR-OIL CYLINDER has chrome plated ID. Center head is sealed with O-rings reinformed with back-ups. Center drain prevents pressure build-up in center head. Lynair, Inc.

Special designs are Universal Hydraulics' regular business, so most of their products are new developments. A cylinder for special mounting (shown) is an example. It was designed for easy installation and maintenance with provision for installing mechanical parts through its center. It simplified the design of a machine and cut cycle time 8 to 1.



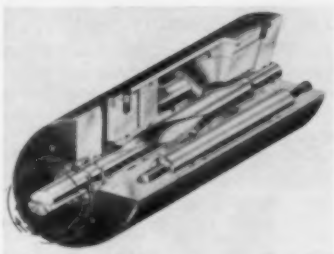
SPECIAL CYLINDER permits passing mechanical parts through center. Universal Hydraulics Div.

Midget air and hydraulic cylinders are new from Control Line Equipment. Rated for 200-psi air and 2000-psi hydraulic they have aluminum pistons pinned (rather than brazed) to a stainless steel rod. Rod threads are on a reduced diameter to prevent damaging rod seals during installation.

Air-operated clamping cylinders in bore sizes from 1" to 3", and air-operated C-clamps are new developments at Airmatic Valve. The clamps can have a manual sleeve valve or an integral solenoid valve, and a number of optional clamping ends. Clamp openings range to 9".

• **New Rotary Actuators**—A new entry in the field of industrial rotary actuators has been Houdaille Industries who has brought out actuators for 3000 psi, delivering up to 741,000 lb.-in. torque. ■

DESIGN SHOW



1005 Carter Controls, Inc.

You'll see . . . rotary torque actuator. Powered by air, gas, water, or oil pressure. Piston-and-helix design allows actuation to be stopped at any point in rotation cycle. Delivers controlled torque to 15,000 in.-lbs at pressures from 5 to 300 psi. From 4½" to 12¾" diameter. Temperatures from —40 to 250 F.

Circle **222** on Reader Service Card

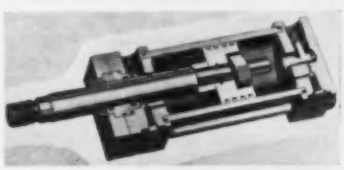
1013 Clippard Instrument Laboratory, Inc.

You'll see . . . miniature air-hydraulic cylinder. For jigs, fixtures and automation equipment. Bore size ⅞". In 1" stroke, spring return and 1", 2", 3", 5", 7", and 9" double-acting models. Power factor is .60, giving 60-lbs force at 100 psi; 1500-lbs at 2500 psi. Electro-pneumatic sequence programmer for timing and cycling will also be shown. Has eight phenolic cams in any combination of eight standard degrees of rotation cuts. May control large pilot-operated valves, or be connected directly to air cylinders.

Circle **223** on Reader Service Card

829 Mo-Bar Hydraulics Co.

You'll see . . . high pressure hydraulic cylinders, 1½" to 12" bore. Pressures from 2000 to 3000 psi. Also medium pressure hydraulic cylinders (shown), 1½" to 14" bore. Pressures from 500 to 2000 psi. And air cylinders, 1½" to 14" bore. To 200 psi. Cylinder mountings will be shown.



Circle **224** on Reader Service Card

IF YOU CAN'T ATTEND THE SHOWS . . .

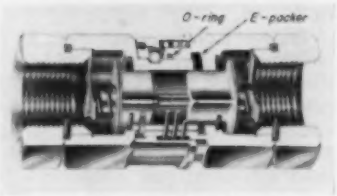
you can get information on these products by circling the Reader Service numbers on the attached post card.

PLUMBING AND SEALS

Some of the biggest advances in fluid power design are taking place in plumbing components and techniques. Manifolds, straight threads, seals are all moving rapidly to keep up with requirements for faster servicing, and better leakage control. Here are some examples of plumbing products which have recently become available.

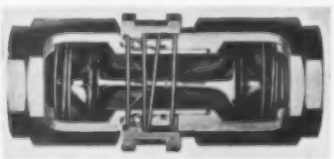
• **Tubing Coupling**—Snap-Tite's quick connect coupling for rigid lines permits quick removal of gages, valves, pumps, and other components. It works similar to quick connects used with flexible hose and can be used with pipe or tubing.

The company's regular line of quick connects has been redesigned to prevent spray when disconnecting lines under pressure. When the coupling is closed, the nipple bears against an E-packer to form the seal. As soon as the nipple is withdrawn during opening, this seal is broken. An O-ring now installed in the coupling maintains the seal until the coupling is completely disconnected.



QUICK CONNECT development for rigid lines above, speeds removal. Coupling design shown below eliminates spray by adding an O-ring to maintain seal. Snap-Tite, Inc.

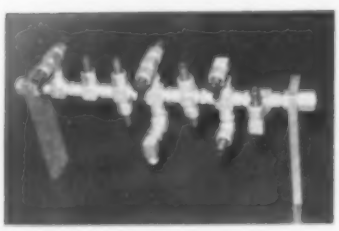
DESIGN SHOW



512 Hansen Mfg Co.

You'll see . . . Two-way shut-off coupling for gas or liquid. Contains identical guided valves in both socket and plug. When disconnected, valves contact valve seats for instant shut-off. Shut-off occurs before plug separates from socket. When connected, socket O-ring seals coupling before valves release fluid flow. Fluid flows freely through coupling. Positive leakage seal due to O-ring compressed in socket against inserted outside surface of plug.

Circle **225** on Reader Service Card



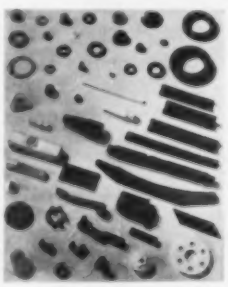
311 Flodar Corp.

You'll see . . . Hydraulic fitting which permits custom assembly of hydraulic manifolds from standard components. Cross, tee, and elbow shapes. Sizes from ⅛" to 2". At least one end has straight-thread, female port with coinable, metal-to-metal seat. Another end has male swivel head. Can connect series of fittings to form manifold. Tube and hose outlets permit piping into and out of manifold. Pressures to 20,000 psi.

Circle **430** on Reader Service Card

146 Dixon Corp.

You'll see . . . various Teflon and Rulon accessories. Parts are made to customer specs for demands of chemical inertness, low friction, high compressive strength, wide temperature tolerance, and lube-free operation. Included are



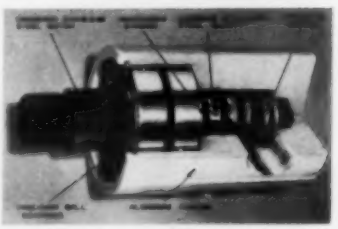
molded and machined bearings, cup packings, bushings, seals and gaskets, O-rings and piston rings, valve components, cable insulation, shaft seals, and ball bearing retainers. You'll see Rulon Spray, an antistick agent, used as a lubricant.

Circle **431** on Reader Service Card

106 Stratoflex, Inc.

You'll see . . . detachable, reusable, and permanently attached hose fittings and assemblies. Rubber and Teflon. Sizes, types, and pressures for all fluid applications.

Circle **432** on Reader Service Card



104 Rotherm Engrg. Co., Inc.

You'll see . . . New revolving joint. Size ½". Handles 500 psi. Speeds to 1500 rpm. Also revolving joint for single and double action air and hydraulic cylinders. Rotates on flat face of a carbon seal which flexes on a pressure sealed ball sphere. Sizes from ½" to 2".

Circle **433** on Reader Service Card

619 Aeroquip Corp.

You'll see . . . Spiral wrap hose. For high pressure hydraulics in sizes from

1¼" to 2". Synthetic rubber inner tube. Multiple spiral wire wrap reinforcement. Synthetic rubber outer cover. Withstands high surge peaks. Temperatures from —40 to 200 F. Hose I.D. from 1.25" to 2", O.D. from 2" to 2.75". Pressures to 3000 psi. Bend radius from 18" to 26".

Circle **434** on Reader Service Card

• **Tougher Seals**—Scoring is a main cause of leakage in dynamic seals. Not only do the wear grooves give a path for leakage flow, but they also abrade the seal, causing further leakage. One answer to the problem is tougher seal materials, and E. F. Houghton has developed their *Rex-Syn* cup packings with this objective. A plastic and an elastomer have been combined to give abrasion resistance, tensile strength of over 3000 psi, and an elastic limit of almost 300%. Friction characteristics compare with the best low friction packings now available.

A metal, lip type seal has been developed by Gits Bros. Mfg. for high temperature sealing in actuators and swivel joints. Its one-piece lip is held in a stainless steel ring which supports the lip axially to prevent blowout under extreme pressures. It can be used for static or dynamic sealing and seals well at low pressures. Dynamic surfaces should have a finish of 8 RMS or better for low breakout friction and best sealing. It can be used as a piston seal, as shown in the illustration, or as a rod seal by building the metal lip on the ID.

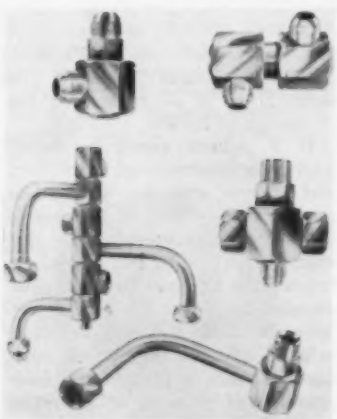
Installing the ferrule the wrong way in a flareless fitting is no longer a problem with Afco Fitting's UF fitting. The ferrule is machined symetrically so that it can be installed either way. After assembly, the ferrule becomes a permanent part of the tube, so that

TEST RESULTS on synthetic rubber packing (left) and new elastomer-plastic compound. Seals were installed in jacks which were run at 205 cycles per minute, through a ½-inch stroke, under 100-psi air pressure. Sand was introduced into the air and replenished as it worked its way behind the seal. Conventional elastomer failed at 27,000 cycles. After 32,000 cycles at 3000 psi, new material showed little wear. E. F. Houghton & Co.

918 Raybestos-Manhattan, Inc.

You'll see . . . molded hydraulic and pneumatic packings. For pressures in industrial equipment. Self-sealing, self-adjusting rings expand on pressure stroke, forming tight seal against stuffing box wall or shaft. On return stroke, rings relax, thus reducing wear. Seals at all pressures, even when pumps or cylinders are not in motion. Pressures to 6000 psi. Temperatures to 250 F. From ½" to ⅞" cross section.

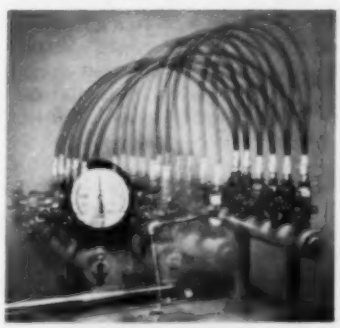
Circle **435** on Reader Service Card



956 Imperial-Eastman Corp.

You'll see . . . Swivel connector. For pressures to 3000 psi. Full 360-deg. rotation. Permits equal pressure against all internal surfaces and seals. As internal pressure increases, cushioning effect between swivel shaft and housing increases. Eight separate sealing parts assure dust-free service. Can be stacked, used in parallel, horizontally, vertically, or as a "T".

Circle **436** on Reader Service Card



1105 Polymer Corp.

You'll see . . . Flexible pressure hose. Nylon inner core. High tensile braided yarn chemically bonded to inner core. Abrasion resistant outer cover chemically bonded to braid. Can be permanently formed to small stress-free bend radii. Pressures to 3000 psi. Temperatures from —40 to 225 F.

Circle **437** on Reader Service Card

105 Greene, Tweed & Co.

You'll see . . . D-W seal. Has D-ring for positive sealing action. Double, wedge-shaped back-up rings provide secondary seal and protect from extrusion. Pressure produces double cam action in wedges. They extend fully against rod and gland O.D. to close rod clearance. Rear wedge ends in a wiper lip. Seal goes into counterbore in cylinder head, held by snap ring. For any fluid. Temperatures from —70 to 600 F. For ½" to 3" rods.

Circle **438** on Reader Service Card

1235 Disogrin Industries

You'll see . . . 4-ft dia. urethane U-cup seal. Made in one piece by compression molding. You'll see wide range of smaller machine components of compression molded and liquid cast solid urethane, such as pump stators and rotors, oil seals, U-cups, O-rings, bellows, belts, wheels, and shock absorbers.

Circle **439** on Reader Service Card

TOOL EXPOSITION

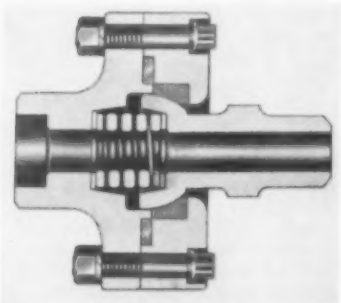
2028 E. F. Houghton & Co. (Also booth 920 Design Show)

You'll see . . . influence of female adapter on V-packing. Exhibit will reveal relative behavior of homogeneous rubber, fabric, metal and phenolic as adapter materials. You'll see rod and cylinder packings, and compatible fire-resistant hydraulic fluids. Includes homogeneous, fabricated, and leather packings. Also water-glycol, phosphate ester, and water-in-oil emulsion fluids.

Circle **440** on Reader Service Card

the fitting can be disconnected without affecting the pressure tight seal. The ferrule has been designed for large contact area with the tube to dampen vibration and prevent stress concentrations. A permanent stop on the sleeve prevents over-torquing and limits tube constriction. The fitting is for steel, copper, stainless steel, and most plastic tubing.

METAL, LIP TYPE SEAL was developed for temperatures to 1500 F. In tests, breakout friction in a 1¼-inch cylinder at 0-psi differential was 5.5 lb. After 14,400 cycles through a 5-inch stroke, the seals and cylinder were in excellent condition. Gits Bros. Mfg. Co.



NEW SWIVEL JOINT specially designed for multiple platen presses is self aligning up to 5 degrees. Barco Manufacturing Co.

• **High Temperature Hose**—One answer to handling higher temperature fluids in aerospace applications is convoluted metal hose reinforced with metal braid. A recent Flexonics development is their *Hi-Flex* hose which has improved flexibility, pressure rating, and fatigue life. It comes in sizes from ¼" to 1¼". Pressure ratings range to 4500 psi in the smallest size.

Another development important in aerospace and ground support applications is higher pressure Teflon hose with metal braid reinforcement. Resistoflex has increased pressure rating of its *Fluoroflex T* hose to 6000 psi. Temperature range of the hose ranges to 400 F and higher. Swaged fittings have lip seals which use both compression and internal pressure for sealing. A compressed, coned disc seat forms the metal-to-metal seal between nipple and lockring.

Hunt Valve is now supplying sub-plates for large valves (weighing up to 700 lb) for use in water hydraulic systems. Sub-plate mounting which provides easier maintenance, reduces downtime, and avoids disturbing piping introduces better leakage control techniques in the primary metals field.

A new swivel joint brought out by Barco Manufacturing for use on hard board, multiple platen presses requires no lubrication and has a chemically inert seal. A new gasket makes turning force very low. The swivel is self-aligning up to 5 degrees from centerline. ■

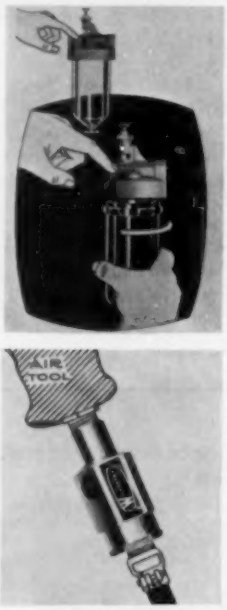
FILTERS, FLUIDS, AIR LINE CONTROLS

For better pneumatic system operation, Wilkerson has introduced products to keep compressed air clean and properly lubricated. Their hose line oiler is small and light enough to install at the air tool. It lubricates in any position and needs no adjustment.

Dirty compressor oil can be just as harmful as water and other dirt, but Wilkerson's new oil-removing air filter removes it before it gets to the machine. The filter has a disposable cartridge and plastic shell for visibility. Baffling throws heavier contaminants to the outer walls, giving a longer cartridge life.

When the lubricant gets low in the company's new *Auto-Fill* lubricator, a valve opens and admits more oil from the pressurized oil line. A quick-change bowl is removed by touching a lever and turning. It's not necessary to turn off air pressure.

Maintenance men don't remember to drain compressor tanks each day, but a new automatic tank drain has a perfect memory. The small drain is all brass and has no springs or lap fits.



HOSE LINE OILER is small enough to install at the air tool. It can be filled without turning off air. Quick-Change lubricator bowl removes by pressing retainer and rotating a ¼ turn. Wilkerson Corp.

R. P. Adams' newly developed *Economat* combines an aftercooler and cyclone separator with a feature to restore 1/3 of the usable volume of compressed air that would otherwise be lost in cooling. It uses the original heat of compression to reheat the air. It performs basically the same function as a refrigerated unit which cools the air before it goes to the compressor, but requires no operating power and gives year-round performance.

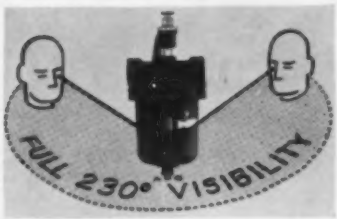
• **F-R Fluids and Filters**—New fluids coming on the market include Shell's fire-resistant, *Irus 902*. The emulsion type fluid now has wear reducing additives to give longer pump life.

Inverted emulsion (oil in water) fire-resistant fluids present filtering problems because of their dirt-

SUCTION FILTER developed for emulsion type fire-resistant fluids has 3/64-inch openings, four magnets. Schroeder Brothers.

carrying characteristics and varying viscosity. Paper elements are not suitable because they remove additives. Working with a fluid manufacturer, Schroeder Brothers has developed a perforated metal suction strainer. It has 3/64-inch holes and four magnets. Flow is directed past the magnets which retain particles down to fine micronic sizes. Opening the strainer size and allowing the magnets to do the collecting job, reduces the chances of pump starvation. For filtration of fine non-metallic particles, Schroeder uses a 60-micron wire mesh filter in the pressure or return line. This also shears the fluid and prevents it from collecting into larger globules. This maintains stability of the emulsion. ■

DESIGN SHOW



107 Wilkerson Corp.

You'll see . . . Saf-T-Bowl for compressed air filters and lubricators. Bowl is die cast of zinc alloy, and has a sight level indicating gauge that can be rotated to face any direction. Temperature, pressure, and corrosive resistant. Indicator is made of pyrex tubing protected by a thin metal strip along its length. Visibility 230 deg.

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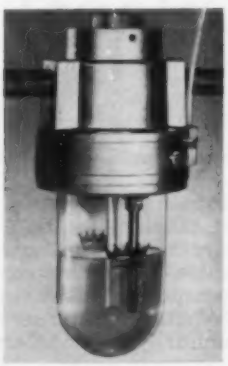

544 Parker-Hannifin Corp.

You'll see . . . Pulse lubricator (shown). System operates on pressure pulses, independent of air flow rates and flow periods. Outlet end of oil delivery line may be placed in any location, allowing metered oil delivery to exact spot desired. Positive lubrication even when equipment is in high, overhead places, or air flow is poor. Oil flooding of air line eliminated. You'll see type 303 stainless steel sealing ring for use on straight thread fittings, where conventional rubber O-ring with back-up washer is not acceptable. Needs no replacing with repeated use. No deterioration.

Circle **442** on Reader Service Card

1117 Screen Products, Inc.

You'll see . . . Stack-type filter (shown). Individual elements are assembled to form various lengths. Each element has aluminum central member and two adjacent filter screens. Metal binder protects screen I.D. O.D. sizes from 1¼" to 3½", I.D. from .63" to 1.7". Filter area from .69 sq. in. to 8.93 sq. in. Also pleated-type filter. For uses requiring small envelope diameters and fine particle retention. Filter ratings to 5 micron. Fluted sheet metal members, extending radially, proved clear flow passages and support for the fine wire cloth.

Circle **443** on Reader Service Card

PUBLICATIONS

HOW TO SELECT QUICK-CONNECT COUPLINGS . . . Nov., 1960
8 pages discussing the design factors which a user should consider in selecting a coupling. Sectional drawings of various designs.

WHAT YOU CAN GET IN ROTARY ACTUATORS . . . Aug., 1960
6 pages showing designs, operating specifications, and application ideas.

PLASTIC LINES—CAN THEY MEET YOUR FLUID POWER NEEDS? . . . Apr., 1960
This report boils down the characteristics of various types of plastic tubing—the "do's" and "dont's" for successful applications.

DESIGNING MACHINE CONTROLS FOR AUTOMATIC ASSEMBLY . . . May, 1960
12 pages showing in detail how electrical and pneumatic components are ingeniously combined to speed up an assembly operation.

WHAT TO LOOK FOR IN AIR VALVES . . . Apr., 1959
16 pages describing and illustrating basic designs of directional, pressure, and flow control valves.

HOW FIRE-RESISTANT FLUIDS ARE USED TODAY; and PACKING MATERIAL FOR F/R FLUIDS . . . Nov., 1958
8-page report describing applications and characteristics of F/R fluids. Includes chart of packing materials for F/R fluids.

TEMPERATURE CONTROL IN HYDRAULIC SYSTEMS
16-page report on system design, fluids, packings. Components affecting temperature control.

ELECTRICAL CONTROLS FOR FLUID POWER SYSTEMS
8 pages of charted specifications for limit switches, timers, solenoids, and pressure switches.

A COURSE IN HYDRAULIC VALVES—Part 1
Directional Control Valves, WHAT 3-POSITION AIR VALVES CAN DO Feb., 1961
Basic characteristics of spool, packed plunger, rotary, poppet, sliding plate valves. Air valves article discusses center porting of 3-position valves. 12 pages.

Reprint prices:
1—10 copies—50c ea.
10—24 copies—35c ea.
25—49 copies—25c ea.
50 or more —15c ea.

Revised JIC HYDRAULIC STANDARDS
32 pages of standards adopted April 1959:
1—10 copies—75c ea.
10—24 copies—60c ea.
25—49 copies—50c ea.
50 or more —40c ea.

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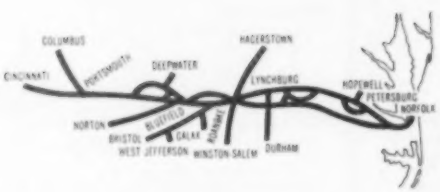
$385,200 in annual savings for an air or gas compressor plant!



N&W

NORFOLK and WESTERN RAILWAY

GENERAL OFFICES • ROANOKE, VA.

Nation's Going-est Railroad

Look at these facts, uncovered by Fantus Area Research in its study of N&W territory!

Fantus analyzed markets, labor, raw materials, taxes, industry trends . . . every facet of plant location. This study uncovered ideal sites for a compressor manufacturer. Estimated operating costs at these sites were compared with actual operating costs of compressor plants in other parts of the nation. At the N&W sites a compressor plant can save as much as $385,200 annually in transportation, and other costs.

Get the full facts. Write on company letterhead to H. P. Cotton, Assistant Vice President, Norfolk and Western Railway, Roanoke, Virginia.

MANY OTHER TYPES OF INDUSTRY can slash operating costs with plants in N&W territory. Fantus proves it in dollars and cents.

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NOW, buy only the horsepower you need with REULAND'S new Hydraulic Pump Motor Intermediate* H.P. Ratings!

Tailor motor h.p. to your pump's performance curve.
Reduce motor costs... increase operating efficiency.

If you're an O.E.M. or user of hydraulic pumps, Reuland's twelve new "in-between" hydraulic pump motor ratings can start saving you money as of *today*. No longer must you pay for overmotoring... no longer must you compromise operating efficiency with an unneeded, over-size motor. *Now you pay by the horsepower... and buy only what you actually need to match the performance curve of the pump!*

Reuland's new intermediate ratings are an important sequel to *another* famous Reuland first... the original, internal spline coupling method of hooking up motor and pump!

All ratings are standard and available for quick deliveries. New price lists and engineering data sent on request. You should have a copy.

Refer to Sweet's 1961 Product Design File, 7a/RE

MODERN POWER FOR MODERN-DAY PRODUCTS

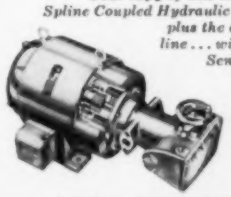
... all in lightweight, cool-running aluminum frames!

28 horsepower ratings from ½ through 60... 12 brand new, exclusive, intermediate ratings!

½	¾	1	1½	2	2½*	3
4*	5	6¼*	7½	8¾*	10	12½*
15	17½*	20	22½*	25	27½*	30
32½*	35*	37½*	40	45*	50	60

*Exclusive, new intermediate ratings.

Your copy of this catalog on Reuland Spline Coupled Hydraulic Pump Motors... plus the complete Reuland line... will come in handy. Sent free on request.



REULAND MOTORS

REULAND ELECTRIC COMPANY
Western Division: Alhambra, California
Eastern Division: Howell, Michigan
Distributors in all principal cities

Circle **146** on Reader Service Card

Cutler-Hammer cuts costs

In 1951, following mechanical improvements on the hydraulic system powering its plastic molding presses, Cutler-Hammer found that oxidation and emulsification of a low-grade hydraulic oil resulted in sticking valves, high oil consumption, costly replacement of worn main ram packings. Change to a premium Mobil oil and installation of a centrifuge for water and contamination removal reduced ram packing wear by 75% and resulted in a reduction in valve sticking and oil consumption. After 9 years, with periodic oil analyses by Mobil, the original fluid fill is still in service. Savings: $5,484 in 1959 alone.

Mobil

with Mobil_saves $13,300!

Leading manufacturer of engineered electrical systems benefits from Mobil Correct Lubrication, realizes economies in wide range of operations, saves $13,300 in one year alone

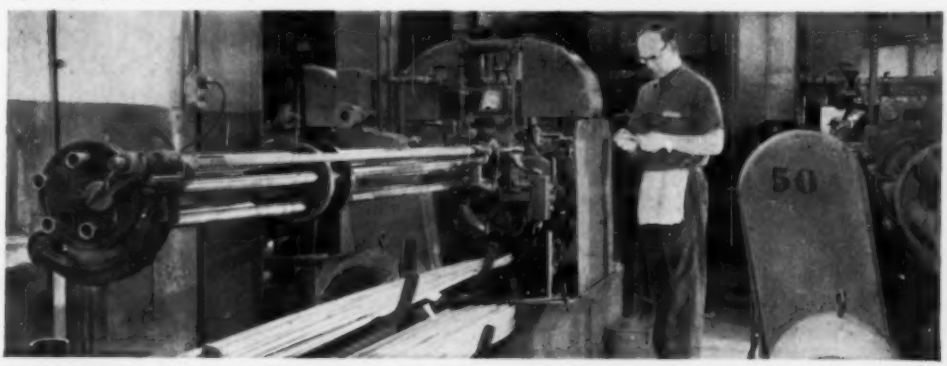
A pioneer in the production of electric controls, Cutler-Hammer, Inc., has for many years relied on a Mobil Program of Correct Lubrication for its several Milwaukee plants. The Mobil Program has consistently brought benefits to Cutler-Hammer—in terms of increased production efficiencies and maintenance dollar savings.

Working in close liaison with Cutler-Hammer technical personnel, Mobil Engineers have made recommendations and suggestions in many areas where lubrication is a factor. These recommendations—a few of which are itemized below—resulted in a saving of $13,300 to Cutler-Hammer in 1959.

Your plant may profit from a Mobil Program too. For further information, call your Mobil Representative. Or write, Mobil Oil Company, 150 East 42nd Street, New York 17, New York.

To guide lubrication personnel in performing required services, Mobil developed complete lubrication charts for machines at Cutler-Hammer, worked out oiler routes and schedules, and recommended use of time-saving lubrication cart. Increased efficiency permitted reassignment of a maintenance man, reduced other overhead, saved $7,452 in 1959—principally in the Press Department.

A Mobil recommendation covering quantity deliveries of oils and greases proved advantageous to Cutler-Hammer. After studying Cutler-Hammer's requirements, Mobil recommended that lubricant purchases be consolidated to permit carload deliveries beginning in 1955. These carload deliveries made possible discount savings which last year amounted to $364.



In Cutler-Hammer's screw machine department, a central cutting oil system serves many machines. Contamination of cutting fluid by lubricating oil frequently reduced machining efficiency to the point where tolerances, tool wear, poor finishes and excessive smoking became serious problems. Mobil Engineers have helped greatly to reduce these problems by periodically analyzing cutting oil characteristics and after each analysis, prescribing corrective action to restore maximum machining efficiency.

Correct Lubrication

Circle **120** on Reader Service Card

How adapters affect "V" packing performance

The widespread popularity of "V" type packings is largely due to their versatility. For low pressure applications, a single "V"—with male and female adapter—may be sufficient. A set, incorporating many "V's", can withstand pressures well over 50,000 psi. They are used in cylinders (inside packed) and on rods (outside packed).

The overall performance, both sealing efficiency and service life, however, is largely dependent on the adapters which support the packings —and primarily on the female adapter because it supports the entire set. Excessive friction, packing extrusion, short service life and failure to properly seal can all result from adapters that are oversize, undersize, or made from materials not suited to the application.

Common Adapter Materials

Adapters are usually made of metal, phenolics, hard homogeneous rubber, fabricated rubber or leather. Each material has its merits and its limitations. In this group there is a range from hard, non-compressible materials to those that are softer and compressible.

What The Female Adapter Must Do

As we said earlier, the female adapter supports the entire set. But that's only part of its job. It must be hard enough to prevent extrusion of the "V" under pressure. Yet it must be soft enough to compress without fracturing. It must "breathe"—compress and flow radially under pressure then recoil when pressure is reduced thereby bridging the metal clearance.

Since "V" packings are in the category of "lip" type packings, their sealing action is due to the force of the actuating pressure expanding the packing. As a result of this "breathing" action, friction on the return stroke is negligible.

Adapter Material Selection

Now to get back to adapter materials. Metal, usually brass or bronze, is hard and inflexible. It can be machined so that the clearance is held to a minimum but it cannot breathe with the packings. Excessive friction and wear usually result.

Phenolic adapters are only slightly better. They "breathe" very little and at high pressures often fracture.

Hard homogeneous rubber, fabricated rubber or leather adapters are superior to both metal and phenolics. This is because these materials are compressible—they will "breathe" with the packing thus bridging the clearance and eliminating extrusion without unnecessary friction.

Homogeneous rubber adapters should be of about 55 Durometer on the "D" scale, fabricated rubber should be a fairly hard texture, and leather adapters are usually impregnated with a hard wax.

Houghton, the only manufacturer of both packings and fluids for hydraulics, has widespread experience in packing design, application and performance. For unbiased recommendations and help in improving packing performance, write E. F. Houghton & Co., 303 W. Lehigh Avenue, Philadelphia 33, Pa.

METAL ADAPTER

PHENOLIC ADAPTER

HOMOGENEOUS RUBBER ADAPTER

FABRIC ADAPTER

Houghton

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Circle 166 →

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Only T-J's complete line can assure you a cylinder of either air or hydraulic application—with practically limitless design specifications for bore, stroke, pressure range and even delivery requirement. From the time-tested, standard tie-rod air and hydraulic, to the exclusive T-J Spacemaker, and including the recently introduced Squair Head, T-J cylinders give you more features for efficient, long-lasting operation. Write today!

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FLUID POWER AT WORK

keeping up with design, application, methods

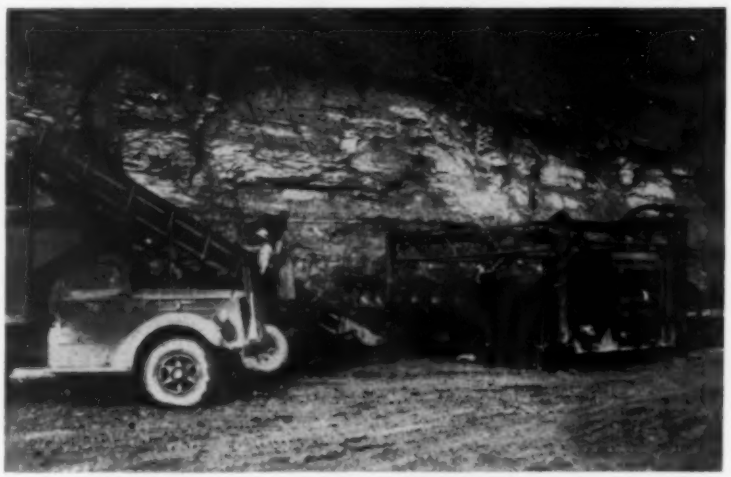
Cylinders walk auger miner

This mining machine uses a 48-inch diameter auger to mine coal in tight quarters along a coal face. Rapid, high-wall augering is possible because the machine is self-positioning. No rails, skids, or separate power units are needed. Cylinders move it horizontally and vertically.

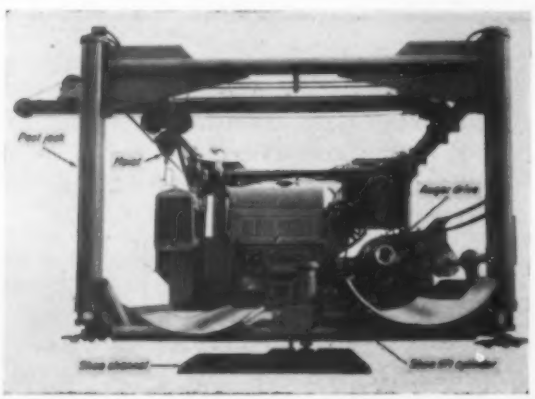
Three cylinder-actuated shoes lift this auger miner and shift it to its next drilling position. The auger miner is leveled and positioned vertically at each new hole by four independently-controlled hydraulic jacks. The miner shifts horizontally and resets for drilling a new hole in three minutes.

Each of the three shoes has two cylinders: one to elevate and one to shift. After a hole is com-

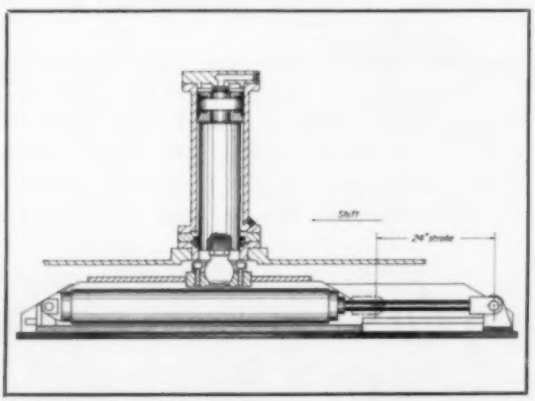
Continued on page 67



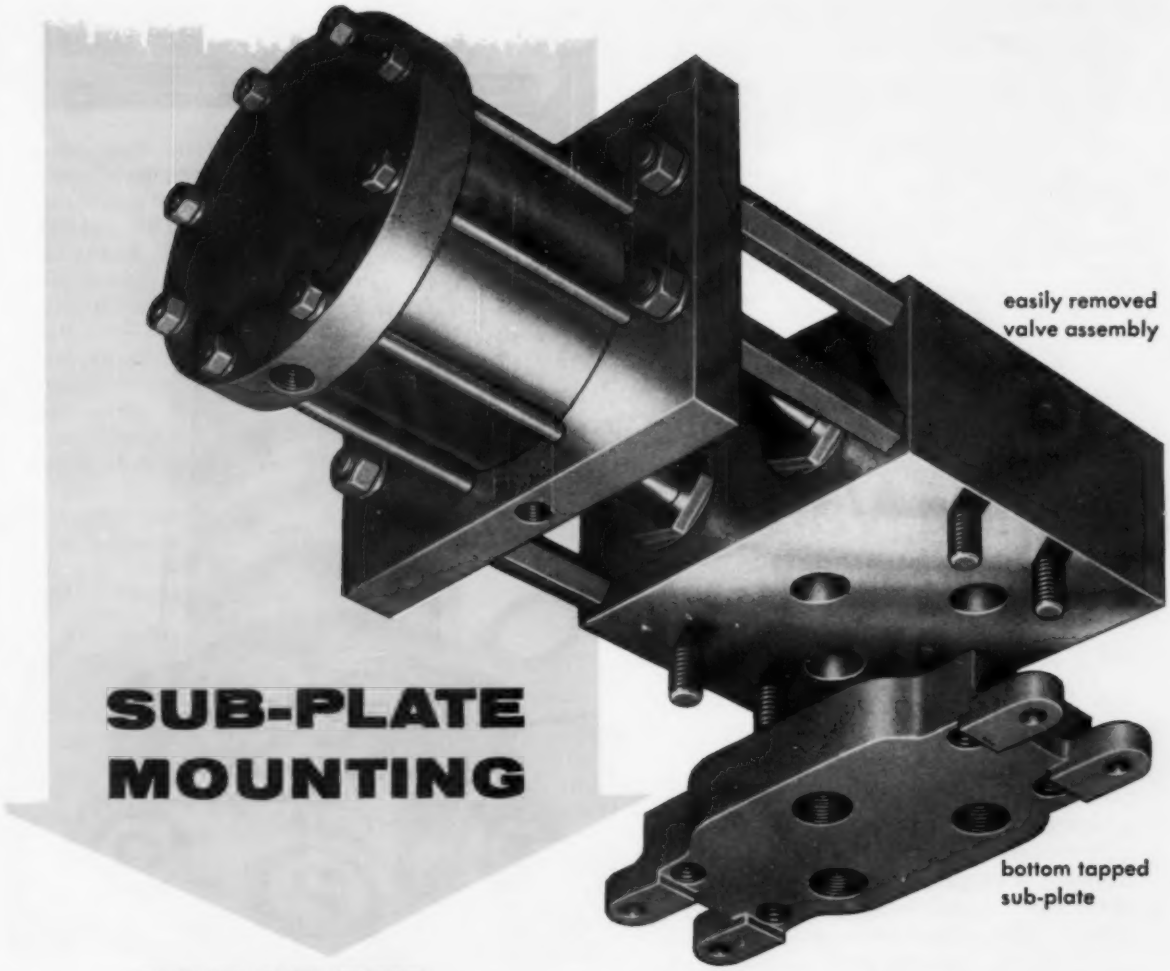
AUGER BORING INTO COAL FACE is controlled by centrally located multisection valves. Four post jack levers are mounted together and give individual control of the four jacks. All the shoe control levers also are mounted together. Two levers control the front shoe and two control the back two shoes.



THREE SLIDING SHOES (2 in the back) raise the auger miner 10 inches off the ground. It slides 24 inches along its shoe channel when its shift cylinders extend. After the slide, the four corner post jacks extend to lift the shoes (and the miner) off the ground, so the shift cylinders can retract.



LIFT AND SHIFT CYLINDERS on each of three sliding shoes make the auger miner self-positioning. It moves itself to or from the coal face as well as from hole to hole.



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Designed to fit into today's preventive maintenance programs, Hunt's new sub-plate mounting permits quick valve removal and installation.

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Sub-plate mounting is available on all ½ through 2 in. Hunt hydraulic valves.* To learn more about the performance and cost-cutting advantages of Hunt valves, contact your nearby Hunt representative.

*Except those with cast or forged bodies.

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3002

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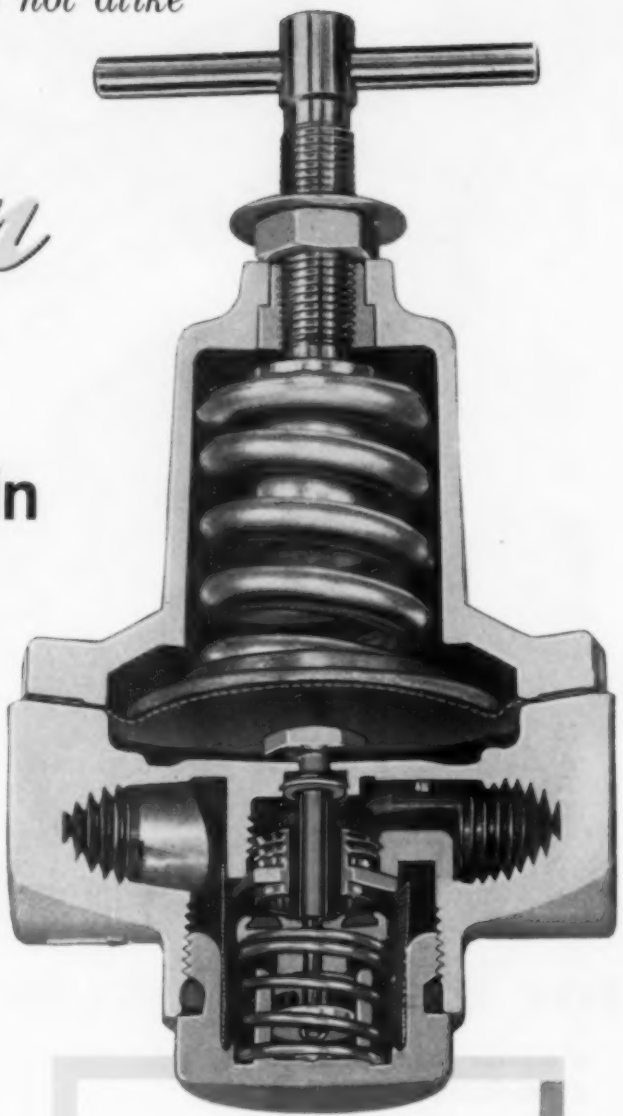
A Norgren extra that assures leak-proof seating of the regulator valve



A tight, leak-proof seating of the valve is essential to the proper performance of a pressure regulator. Leakage and creep can be caused by improper alignment of the valve-pin, resulting in gouges and excessive wear on the valve seats.

To prevent this, Norgren Regulators are made with a floating valve-pin, eliminating critical alignment problems. The Norgren floating valve-pin is self-aligning, assuring positive seating of the valve. As a result, there is minimum wear on the valve seat, with increased service life and more dependable regulator performance.

Whatever your pressure regulation need, there is a Norgren Pressure Regulator designed for the job. Call your nearby Norgren Representative listed in your telephone directory—or write factory for literature showing complete Norgren Regulator line.

Norgren Pressure Regulators give you these important features:

Balanced Valve Construction—
improved regulator performance

Large Nylon-reinforced Synthetic
Rubber Diaphragm—long service life

Baffle and Siphon Tube—
increased accuracy

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Easy servicing while still on fluid-line

Floating Valve-Pin—
assures better seating

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pleted, each channel-like shoe is manually pointed in the direction the miner is to move. The ELEVATE cylinders lift the auger miner off the ground. The SHIFT cylinders then extend and push the miner along the shoe channel in the direction the shoe was pointed. The ELEVATE cylinder has a 10″ stroke. The SHIFT cylinder's 24″ stroke permits the miner to take 24″ steps. The shoes swing on ball swivel joints permitting the shoes to rotate 90 degrees to each side of a perpendicular to the coal face. Thus the miner can move toward the wall, parallel to it, or at any angle between.

• **Advantages Over Wheels**—One advantage of these sliding shoes over wheels is that the mechanism to move and guide a wheel would be more complex than the shoe's swivel joint and channel. Also the channels support and move the auger miner on soft ground where tires would sink. The shoes nest within the frame when not in service.

The operator controls the shoes through a multisection control valve. One lever for elevate and one for shift controls both rear shoes, because they are connected in parallel. The front shoe is controlled by separate valves.

• **Jacks Give Adjustable Height**—Each of the four, corner hydraulic jacks are independently controlled through a 4-section valve. The outer cylinder of the jack is 8″ pipe. Bearing rings at the bottom of the outer cylinder and at the top of the inner cylinder take side loads which occur during drilling. The jacks' 73″-stroke permits boring holes one over the other for greater coal recovery when the vein is thick enough.

The auger miner has three gear pumps within one casing. The two larger ones each have a 34-gpm capacity at 1000 psi. The smaller one has 15-gpm capacity at 2000 psi. A 65-hp, auxiliary diesel en-

Continued on page 70

build reliability, flexibility, versatility into your hydraulic system...

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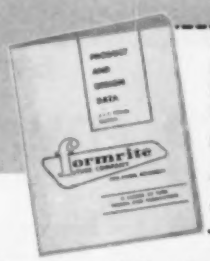

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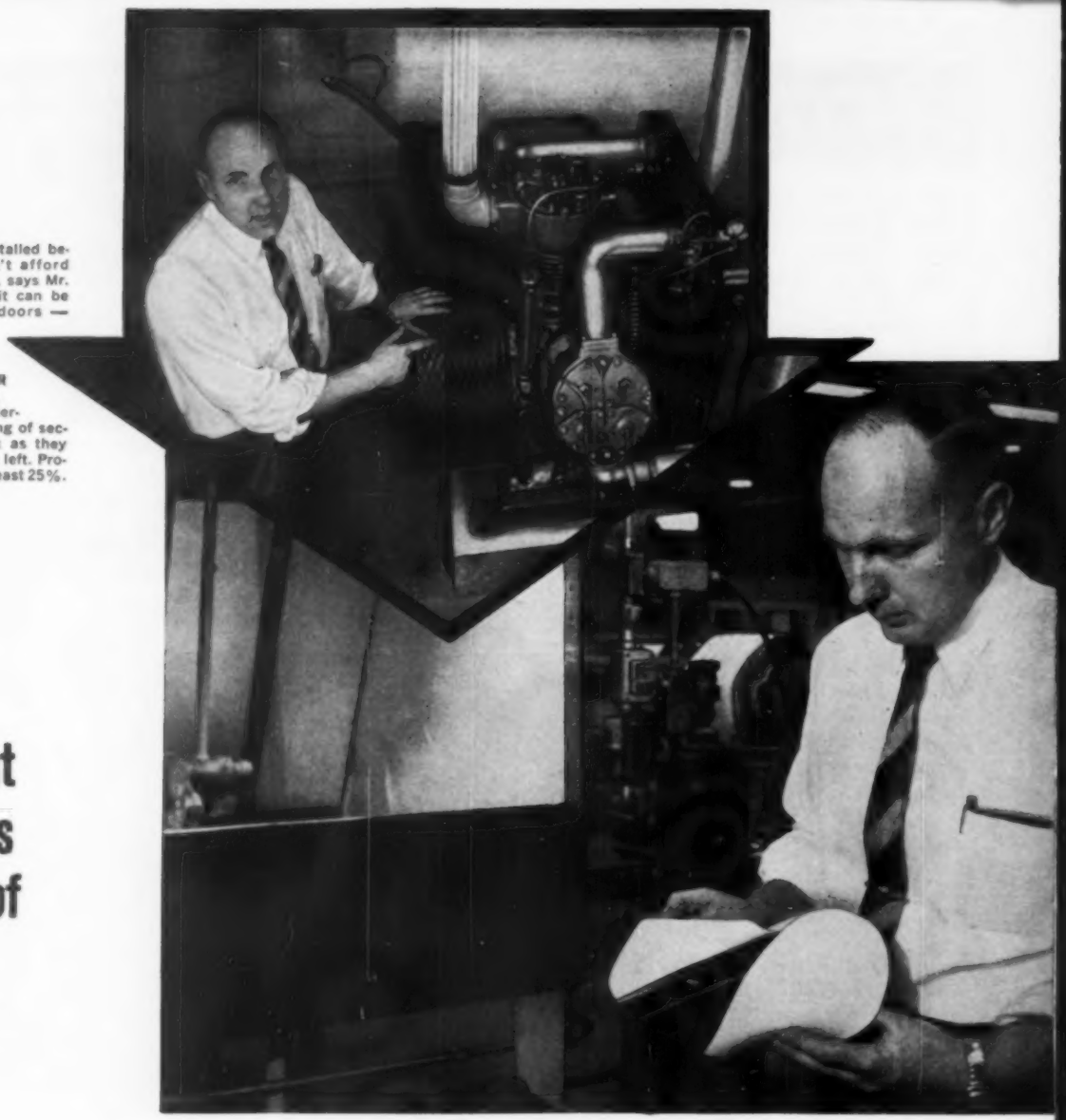

LE ROI 50S2 was installed because Bowes couldn't afford compressor downtime, says Mr. LaFara. Air-cooled unit can be used indoors or outdoors — needs no plumbing.

FINISHED TIRE REPAIR SECTION is inspected. Compressed air now permits automatic spraying of sections with liquid latex as they pass through booth at left. Production increased at least 25%.

This plant minimizes the risk of "no air - no work" with a

LE ROI 50HP STATIONARY COMPRESSOR

A dependable compressor headed the list of critical needs when Bowes Seal Fast Corp., of Indianapolis, Ind., merged two plants under one roof. A Le Roi 50S2 two-stage compressor provides this vital dependability . . . and all the compressed air needed to produce over 2000 various items for the upkeep of cars, tires, and tubes.

James S. LaFara, Plant Manager, reports that the Le Roi unit delivers 210 cfm at 125 psi . . . operates 75% to 80% of 8- to 16-hour production days, five days a week, and supplies almost 100% of all the compressed air needed. Down-time, he adds, is at a minimum, and maintenance costs are below those of two smaller compressors which the Le Roi replaced, and which now serve only as standby units.

Look what this Le Roi 50S2 does! It provides air to spray tire-repair sections (boots) and tubeless-tire repair plugs with a mixture of liquid soap and water. The unit powers latex spraying machines, and blows scraps from tube-patch cutting machines. Other uses include air for lead moulding equipment, nut-driving units, cleaning vents on chemical filling machines, and for the plant's fire-protection system.

Are you looking for a "dependable" compressor? Check the complete line of Westinghouse unit-type and Le Roi stationary air compressors — from ½ to 100 hp. Contact your Le Roi distributor, or write to Le Roi Division, Westinghouse Air Brake Co., Sidney, Ohio.

50-98

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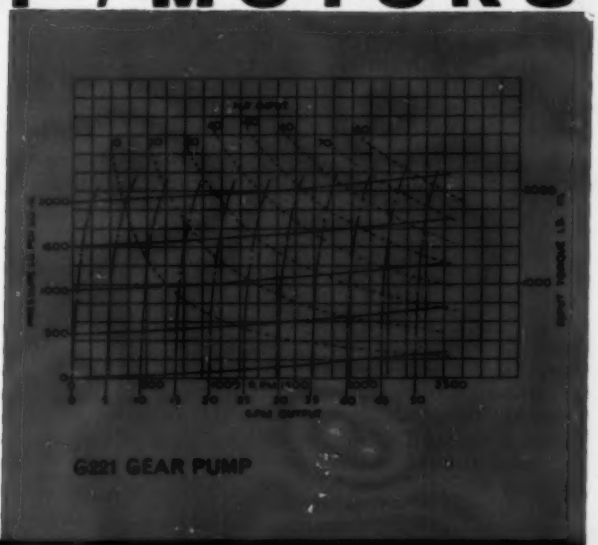
One of the new heavy duty gear pump/motors designed for high continuous rating.



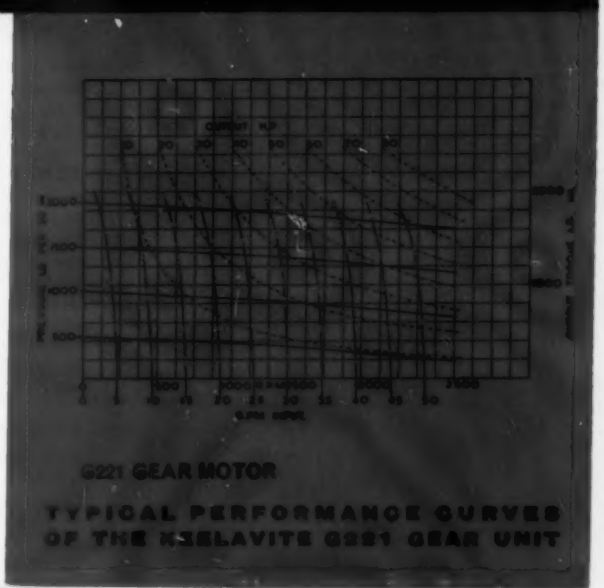
G221 GEAR PUMP

KEELAVITE GEAR PUMP/MOTORS

Within the wide range of the KEELAVITE G SERIES of GEAR PUMP/MOTORS, there is a unit suitable for any industrial use. Used as pumps, output ranges from 2.25 gpm. to 180 gpm. Motor torque ranges from 10.5 lb. ins. per 100 psi to 785 lb. ins. per 100 psi.

WHY THEY ARE BETTER

All of the KEELAVITE PUMP/MOTORS conform to a high standard of workmanship in manufacture, and are reversible without alteration in assembly. The whole range stems from six basic sizes and common components are used within each basic size. All units incorporate roller bearings.



G221 GEAR MOTOR

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THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANSMISSION

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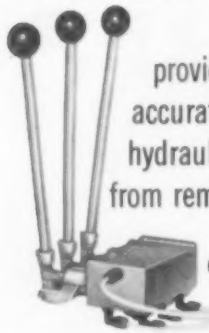
NEW hydraulic
Dynamaster
remote control system



provides positive, accurate control of hydraulic actuators from remote stations

Master Unit

Want *control* at an operator's fingertips, but can't squeeze it in? Solve the problem with a compact *Dynamaster* remote control system. Typical master unit weighs only 6 lbs., measures only 3 x 6 x 7½", less handles.

A continuous, 35 psi supercharging system bleeds air from the "slave" circuit, eliminates "sponginess." Indexing is positive, fail-safe. The system even works when the pump doesn't.

The 3-bank configuration shown can remotely control three forces up to 75,500 lbs., at speeds to 3" per sec. Write for complete information.

Slave Unit — VM6506 slide plate valve

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FLUID POWER AT WORK

gine drives the three pumps, which supply all hydraulic power.

The following functions operate from the two larger pumps:

Auger hoist
Auger retriever
Fast auger feed

These functions operate from the small pump:

Slow auger feed
Auger hoist traverse
Four corner jacks
Elevate and shift shoes

A 235-hp, main diesel engine supplies power to rotate the auger.

Auger sections are 12 ft long and 4 ft in diameter. They have square connections at each end so that section ends fit into each other. Thus the auger extends in 12 ft increments. The auger drills holes into a coal face up to 160 ft long. While one 12-ft auger section drills a new hole, the hydraulically-powered auger retriever pulls an idle auger section out of the previous hole. The auger hoist moves this section into ready position on the miner for connection to the active section when it has drilled 12 ft into the coal seam.

Information for this article was supplied by EDWARD SENNENSKY, *Project Engineer, Long-Airdox Co., Div. of Marmon-Herrington Co., Inc., Chicago.*

Continued on page 72

BRIEF NOTES

CHEMICAL PROLONGS LIFE OF SYNTHETIC RUBBER . . . A rubber chemical that protects and sustains the life of synthetic rubber was announced by Goodyear Tire & Rubber Co., Akron, Ohio. It serves as an antioxidant during production of raw rubber and is retained in the material to act as both an antioxident and antiozonant in compounded stocks.

INVENTOR AWARD WINNER ANNOUNCED . . . Actuation Research Corporation's 1960 annual inventor's award went to Siegfried Kaswan, senior staff designer. He received this honor for inventing a new type balanced, self-aligning, and self-adjusting ball valve.

FLUID POWER DISTRIBUTOR ANALYSIS . . . Questionnaires have gone out to 900 distributors of hydraulic and pneumatic products in a survey of sales, sales management and training, compensation, financial condition, office management, credit practices, and business costs. The comprehensive report which will result from this survey will establish standards for the industry, so that each distributor can compare his own business and spot weaknesses. The survey is being conducted by a committee of seven distributors headed by Roger Scott of Scott Equipment Co., Dayton. Dr. Fred Amling of Miami University will analyze the data and prepare the report.

INTERNATIONAL FLUID POWER MEETING . . . Preliminary plans have been announced for the International Fluid Power Conference scheduled to meet in London in April 1962. Sessions planned will be geared to both component manufacturers and users.

"COLLEGE OF CYLINDER KNOWLEDGE" . . . has a new edition to be shown at the ASTME Tool Show by Miller Fluid Power Div., Bensenville, Ill. The college provides the same basic information seen in earlier editions plus timely new data. Visitors will see displays which include taped talks and demonstrations of cylinders, pressure boosters, and air-oil units in operation.

HYDRAULIC FLUIDS SEMINAR . . . The Milwaukee Chapter, Fluid Power Society, in cooperation with the Milwaukee School of Engineering will present a one-day seminar on May 23rd at MSOE. Speakers will be Edward Yatsko, Shell Oil Co., *Petroleum Fluids* . . . John Mathe, E. F. Houghton, *Fire-Resistant Fluids* . . . Richard Leslie, Vickers Inc., *High Temperature Trends* . . . Ward Diehl, General Motors, *A User's Viewpoint*. Robert Rynders of Racine Hydraulics & Machinery will review NFPA activities in fluids.

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If it's a pressure gauge, dial thermometer, or needle valve, Marsh makes it...makes it in every form to suit every need...makes it better in the opinion of thousands of discriminating users. Only a few key products are illustrated here, but hundreds are described in Marsh Catalogs. Ask for information covering the product or products in which you are interested.

PRESSURE GAUGES

"Mastergauge"—the world's most effective pressure gauge for extreme service.

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Quality series—second only to "Mastergauge" and "Master-test" for tough conditions.

Standard series—best moderate-priced gauge for run-of-plant conditions.

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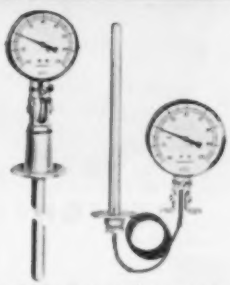
Vapor tension thermometers—direct mounted type. Many sizes; ranges.

Distant reading thermometers—vapor-tension and gas filled types in many sizes; ranges.

Piping thermometers—specially designed for piping. Types for all purposes, including distant reading.



Duct thermometers—specially designed for all conditions including distant reading.

NEEDLE THROTTLING VALVES

Alloy steel—complete series of sizes and patterns. Pressures up to 10,000 psi.

416 Stainless steel—complete series of sizes and patterns in 416 stainless. Pressures up to 10,000 psi.

316 Stainless steel—complete series of sizes and patterns in 316 stainless. Pressures up to 6,000 psi.

Panel mounted—all valves—alloy steel, 416 stainless, and 316 stainless—available in panel mounted types.

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Up to 12000 PSI Operating Pressure
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Pressure Balanced
Stainless Steel Throughout
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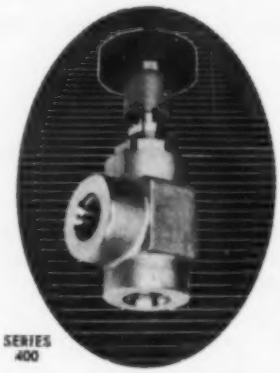
Panel Mount in 1 Minute
Service Completely from Panel Front



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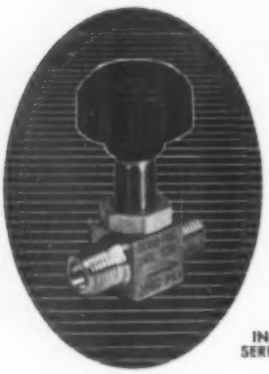

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Male or Female Ports
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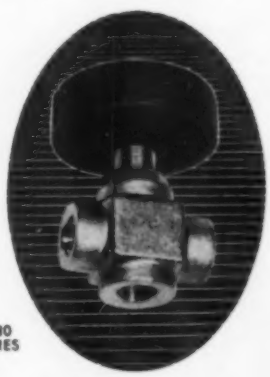
For Air-Nitrogen-Helium-Fuels-Hydraulic Oils-Water

DESIGNED TO SAVE YOU MONEY!

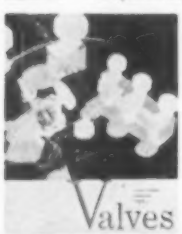
Three-Port
Hi-Vacuum to 6000 PSI

Versatile . . . May be used as a three-port valve with two ports in common, as a globe valve or as an angle valve. A relief valve, pressure gauge, or other device may also be installed in third port.

Simplifies Stocking Problems Stock 1, Serve Many!



T180 SERIES



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FLUID POWER AT WORK

NCIH Planning Progresses

Plans for the October 1961 National Conference on Industrial Hydraulics are almost complete. Frank Mackin is director for 1961.

Versatility and Reliability of Fluid power is the theme for the 1961 conference. A high level of professional competance will be emphasized in the papers. The conference format, theme, and papers will define and report solutions to technical problems concerning new developments.

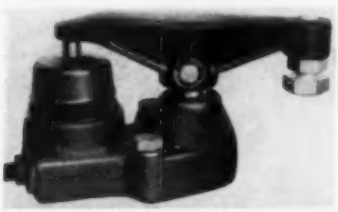
Over twenty papers are being scheduled for the two day conference.

Machine Centers Billets for Seamless Tubing

A precision billet centering machine for the manufacture of seamless steel tubing, was recently installed at the Ohio Seamless Tube Division of Copperweld Steel Co., Shelby, Ohio.

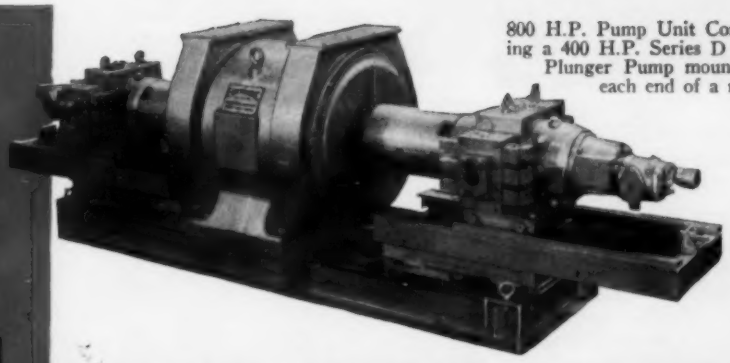
Improved concentricity at the starting end reduces crop shell loss. The increase in center hole

Continued on page 74



WHEN HYDRAULIC pressure is applied to this clamp, a small horizontally positioned hydraulic piston swings the clamp arm 90 degrees from its normal rest position to the clamping work position shown. As hydraulic pressure builds up, a vertical cylinder is then pressurized. This cylinder rocks the arm about its pivot pin to clamp the work. Normal clamping pressure is 900 lb at 2000 psi. Manufactured by Newton Hydraulic Tolling Co., Auburn, Mass.

If it's Power Pumps large or small . . . it's



800 H.P. Pump Unit Comprising a 400 H.P. Series D Axial Plunger Pump mounted at each end of a motor.

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(PATENTS) LTD. ROOLEY NR LEEDS, ENGLAND

Control Desk for 2500 Ton Forging Press.

CANADA and USA

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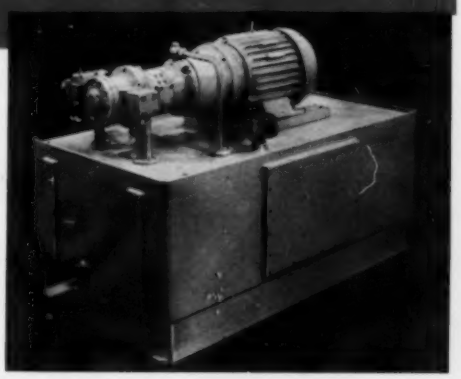
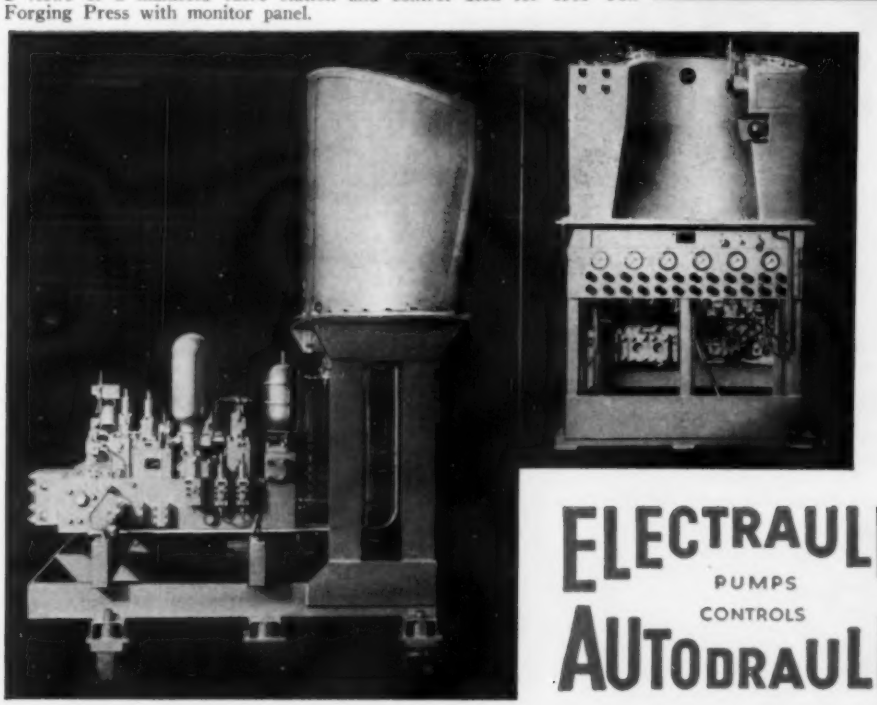


Tank mounted high & low pressure pump unit

2 views of a manifold valve station and control desk for 1500 Ton Forging Press with monitor panel.



ELECTRAULIC

PUMPS

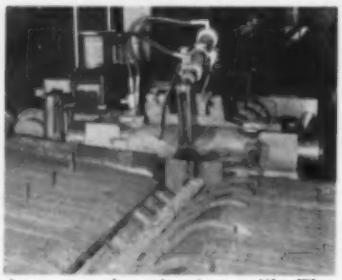
CONTROLS

AUTODRAULIC

FLUID POWER AT WORK

depth will facilitate piercing of the tube round.

After a billet is positioned between gripping jaws, a hydraulic cylinder closes the jaws with a force of nearly 190 tons and moves the centering tool into the billet center. The centering tool and gripping jaws then retract, and the billet is ejected. Table kickout removes centered billet which continues to the piercing mill. The machine can handle tube rounds 3 to 7 in. OD, 10 to 22 ft long, at the rate of five per minute. Billet weight averages 1100 lbs. ▼▼▼



IIT Offers Summer Course

Functions of pumps, motors, valves and accessories will precede circuitry discussions in a two-week course at Illinois Institute of Technology. Held annually since 1955, the course will last six hours a day, five days a week beginning June 12. It is designed for shop, maintenance, operating, and sales personnel working in industry.

The course was requested by members of the National Conference on Industrial Hydraulics and is offered as an NCIH activity. Tuition is $100 which includes the use of university facilities.

Lectures and topics include:

- D. W. Prosser, Illinois Institute of Technology,—pumps and motors, hydraulic control valves, flow control valves, hydrostatic transmissions, and accumulator sizing and applications
- V. Nelson, International Harvester,—fluids contaminants, and filters
- W. Watson, Racine Hydraulics,—reservoir design, heat exchangers, and temperature controls
- J. Pippenger, Double A Products,—directional control valves, circuitry symbols, and circuits
- F. L. Mackin, Director of NCIH,—basic circuitry
- P. Bauer, International Harvester and Illinois Institute of Technology,—mobile equipment circuits
- A. H. Dall, Cincinnati Milling Machine Co.,—machine tool circuits
- M. Holmgren, Imperial-Eastman Corp.,—hoses, tubes, and fittings
- R. Isenbarger, Chicago Rawhide Mfg. Co.—sealing devices
- Ron Loup, Double A Products,—hydraulic applications in ground support of guided missiles
- H. B. Kolm, Jr., Moog Servocontrols, Inc.,—electrohydraulic servomechanisms
- H. J. Andresen, Hannifin Co.—pneumatics, a field allied to hydraulics
- G. Altland, Vickers,—maintenance and trouble shooting
- W. Williams, Midwest Hydraulics, Inc.—component selection in circuit design.

To enroll in the course, write: D. W. Prosser, Oil Hydraulics Laboratory, 3210 South Federal, Chicago, Ill. ▼▼▼

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Production parts save you money, do the job better! BHEW basic cylinders can easily be modified to fit your *specific* product applications. You benefit from production economies; you get custom-built cylinders.

Let's discuss your design and application problems —

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Write today for Hydraulic Cylinder Engineering Reference data — 78 dimensional basic designs for general-purpose and special-purpose double-acting and single-acting cylinders. SAVE TIME.

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THOMSON

60 Case

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hardened and ground

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60 Case is the result of over 15 years of experimental work and production experience with hardened and ground shafts which are a requirement for BALL BUSHINGS, the Linear Ball Bearing manufactured by Thomson Industries, Inc.

The special techniques and equipment that have been developed enable high production rates and low handling costs. This permits big savings over conventional methods which are plagued with erratic warpage, straightening and resultant grinding problems. Finished *60 Case* parts frequently cost less than the scrap losses that result from conventional methods.

60 Case material has a surface hardness close to 60 on the Rockwell C scale which is essential to resist wear.

Long lengths of material ranging in diameter from ¼" to 4" are stocked to enable prompt shipment of *60 Case* parts, with or without special machining. *Write for literature and name of your local representative.*

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TYPICAL *60 Case* PARTS

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PARTS HARDENED to 60 C...
increase life...reduce cost!

IMPORTANT POWER HYDRAULIC PUMP

QUIET OPERATION

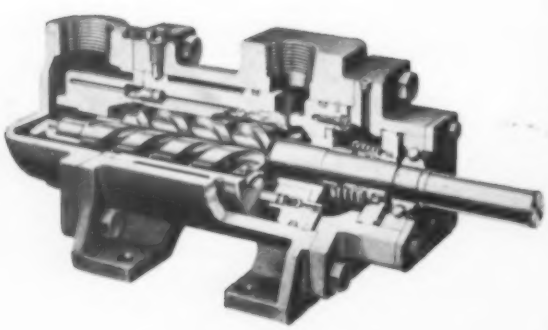
The smooth rolling action of the DeLaval IMO® pump eliminates noise, vibration, and hydraulic whine. There are no reciprocating parts to wear and become noisy. "Hospital quiet" is assured. This is why the noise-conscious elevator industry has virtually standardized on the IMO pump for hydraulic passenger elevator installations. For the same reason, the Navy uses IMO pumps for practically every submarine hydraulic service.

RELIABLE OPERATION

IMO pumps require no timing gears, cams, valves, sliding vanes or reciprocating parts. There is nothing to get out of order, nothing to adjust. IMO pumps for lube oil and fuel oil service are on almost all U. S. Navy combat vessels. They demonstrated their reliability so completely during World War II that the Navy removed IMO pump spare parts from many vessels to allow extra ammunition to be carried.

HIGH SPEED

Only the IMO pump has proved acceptable for integral mounting on high-speed machinery, such as turbine governor controls. Standard types have given dependable, quiet operation at speeds up to 12,000 rpm. Special types have been built for operation at 24,000 rpm pulling a lift. For many applications at 1750 and 3500 rpm motor speeds, the IMO pump means lower-cost drives.



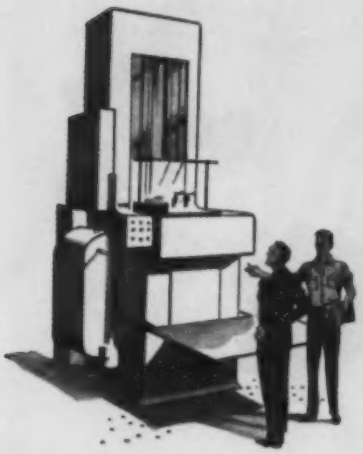
How the IMO Pump works

The DeLaval IMO pump is a constant-displacement, rotary, screw-type pump. Fluid is propelled axially in a constant, uniform flow through the action of just three moving parts — a power rotor and two idler rotors. The power rotor is the only driven element, its end being extended outside the pump casing for direct connection to the power source. Idler rotors are turned by the action of the fluid pumped and act as sealing elements, their accurately machined threads conforming perfectly to the threads of the power rotor and the surfaces of the housing cylinder.

Since the idler rotors perform no work; the IMO pump screws need not be connected by gears to transmit power between screws. The sealed closures formed by the meshing of the rotors inside the

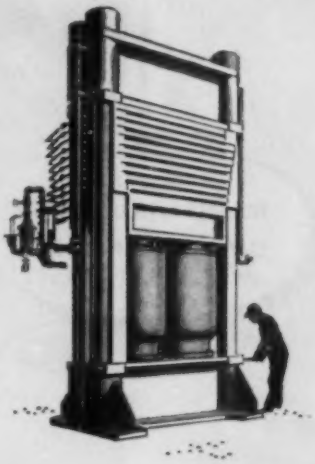
CHARACTERISTICS - Which are vital to you?

NON-PULSATING FLOW



Fluid delivery is continuous, resulting in pulsation-free flow. There are no intermittent strokes, no churning. In many broaching operations pump pulsation can adversely affect the finish which is of utmost importance. A non-pulsating IMO pump is ideally suited to such applications.

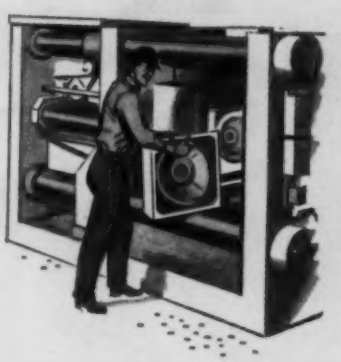
HIGH CAPACITY



A single IMO pump can deliver up to
3000 gpm at 300 psi
1000 gpm at 500 psi
400 gpm at 3000 psi

Because of its wide range of capacities and pressures, the IMO pump is widely used in hydraulic press applications which, as a rule, require high capacities at low to medium pressures for pre-fill service, then low capacity at high pressure during the working part of the stroke.

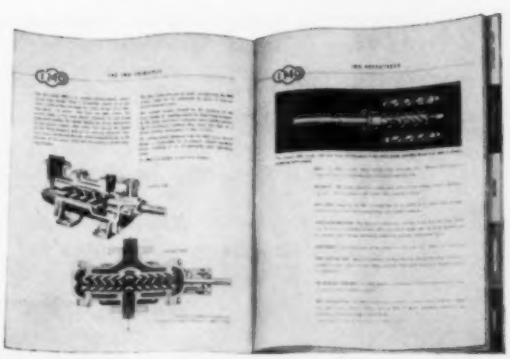
FIRE-RESISTANT FLUIDS



The IMO pump has been applied widely on phosphate ester and water glycol fire-resistant fluids. Although rotary pumps in general have not performed too well when handling water glycols, the standard IMO pump has been applied with excellent results. To apply the IMO pump on phosphate ester fluids, it is necessary only to change seal and "O" ring materials.

housing enfold the fluid being pumped. As the rotors turn, these enclosures move axially providing a continuous, uniform flow much like that of a piston moving continuously in one direction. The rolling action obtained with the IMO pump screw thread design is responsible for its natural, smooth pumping action and results in exceptionally quiet operation.

For application data, selection information, complete performance on each IMO pump model, dimension drawings and tables, write for Bulletin 3200.



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Cat.'s 204, 210, 230 and 261 contain 68 pages describing all valve models, sizes and types with complete working drawings, specifications, performance, ratings, cut-away views. Get free copies today.

RIVETT
HYDRAULIC VALVES

What the affiliation of Rochester Manufacturing Co. with American-Standard® means to you

Perhaps you read the story in the WALL STREET JOURNAL. "American Radiator and Standard Sanitary Corp. . . . has acquired Rochester Manufacturing Co., maker of gauges and instruments. Rochester Manufacturing will operate as a part of American-Standard Controls Division."

There was more. But what is of immediate concern to you is: what does this consolidation of two great names in the field of instrumentation mean to the hydraulics and pneumatic fields?

It means expansion of Rochester Instruments' research and development program, reflecting broader product lines.

It means that the scope of the Rochester operation will be increased to serve industry more effectively.

It means that the complete facilities and capabilities of the American-Standard Controls Division are at your disposal as Rochester engineers work with you.

In short, it means *growth* . . . greater resources and development of important new products to take their place beside Rochester thermometers and pressure gauges—and Detroit TyniSwitches®, Pressure and Temperature controls, Vernatherm thermostats, and Norwood Strain Gauge Pressure Pickup.

We look forward to the opportunity, as we always have, to help you keep pace with America's growth and development, but now we meet the challenge with a greater abundance of resources.

RMC *The familiar RMC trademark,* symbol of quality instrumentation, has undergone a design change as a result of the affiliation of Rochester Manufacturing Co. with American-Standard. Here *(right)* is the new trademark for Rochester Instruments, and this is our new name: American-Standard Controls Division, ROCHESTER INSTRUMENT PLANT, 209 Rockwood Street, Rochester 10, N. Y. (also ROCHESTER INSTRUMENTS, 1401-C South Shamrock Ave., Monrovia, Calif.)

AMERICAN-Standard
CONTROLS DIVISION

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Rochester Thermometers

Rochester Pressure Gauges

NORWOOD Strain Gauge Pressure Pickup (to 100,000 psi.)

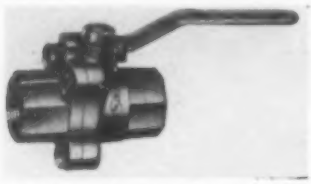
DETROIT Vernatherm

NEW PRODUCTS

Circle the numbers on the Reader Service post card for more information

FORGED BRONZE BALL VALVE

For air, water, oil, gas or fluids compatible with bronze. Valve



seats give positive sealing, in either flow direction, for entire valve life. Spring, retainer ring, and O-ring seal, behind valve seat, insure constant compression, self-adjustment and tight seal, even on low pressure and vacuum lines.

Designation: F-125.—*Ball Valves Inc., Worcester, Mass.*

Circle **300** on Reader Service Card

DOUBLE PUMP POWER UNITS

Can be supplied with two relief valves or hi-lo unloading valve panel.

Specifications: Working capacities,

1000 and 2000 psi. 30- and 60-gal reservoir sizes. Combined pump capacities to 33 gpm. Units have 1800-rpm motor.

Designation: DCP.—*Hannifin Co., div. Parker-Hannifin Corp., Des Plaines, Ill.*

Circle **301** on Reader Service Card

PRESSURE GAUGES

For in-plant and original equipment requirements. Black bonderized cases with blow-out plugs. Brass screwed rings with beveled glass. Type 11 has silver-brazed copper alloy bourdon tube and bronze-bushed movement for pressure media not corrosive to brass. Type 11S has 316 stainless steel bourdon tube, with 303 stainless steel tip and socket, movement of stainless steel and monel.

Specifications: Dial size 2½". ¼" NPT male bottom connection. Ranges are 15, 30, 60, 100, 160, 200, 300, 600, 1000 psi, and 30" vacuum. Accurate to 1% of dial reading.

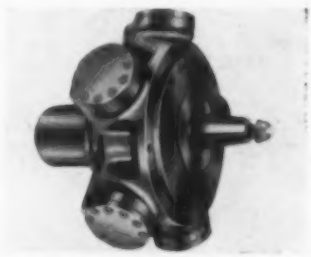
Designation: Service Gauge.—*Marsh Instrument Co., Skokie, Ill.*

Circle **302** on Reader Service Card

HYDRAULIC MOTOR

Higher torque, lower speeds. May be coupled directly to equipment without gear boxes.

Specifications: 7-cylinder model with continuous torque of 6,600 ft-lbs, peaks to 10,000. 5-cylinder model with continuous torque of



4,600 ft-lbs, peaks to 7,000. Speeds from 0 to 75 rpm. (7 cylinder) and 0-100 (5 cylinder). Manufactured by Chamberlain Industries, Ltd. *Double A Products Co., subs. Brown & Sharpe Mfg. Co., Manchester, Mich.*

Circle **303** on Reader Service Card

OIL SEPARATOR

Separates contaminants from oil 12,000 gallons per hr. Operates on principle that oil is lighter than water and solid wastes.

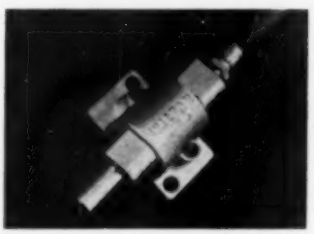
Specifications: Bowl shell, coupling ring and bowl top are type 329 stainless steel; coupling nut and tubular shaft are type 316.—*De Laval Separator Co., Poughkeepsie, N. Y.*

Circle **304** on Reader Service Card

CLAMPING TOOL

Midget power tool for clamping small items. Includes two heads and three holders.

Specifications: Stroke of No. 2800 head is 1", with oil displacement 0.69 cubic inches. Stroke of No.



2100 head is ⅜", with oil displacement 0.345 cubic inches.

Designation: Midget PowRlock.—*Wilton Tool Mfg. Co., Inc., Schiller Park, Ill.*

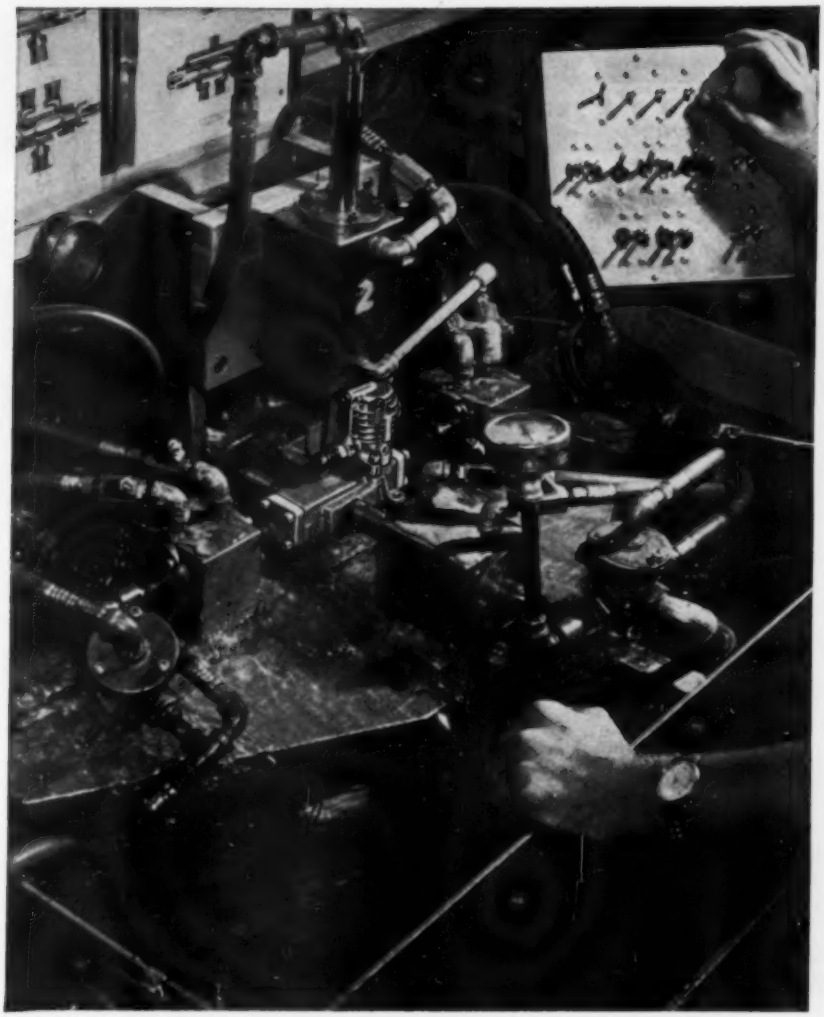
Circle **305** on Reader Service Card

SMALL, MEDIUM AFTERCOOLERS

Features non-corrosive, copper coolant coil. Flanged head and coil may be removed as a unit.

Continued on page 82

test every valve?



Valvair does! How else can any manufacturer be sure that every valve he ships to a customer will function properly, from the first cycle on?

Each Valvair valve is cycled and re-cycled under water, at 30 to 50% above its rated pressure, to be certain that it meets Valvair's rigorous performance specifications. And, this final operating test is just one of the countless rigid quality control inspections each part of every valve must pass during its manufacture. In fact, one out of every twelve Valvair production men is a full-time inspector. Parts are scrutinized in process, as well as just prior to assembly. The most modern types of equipment, including optical comparators, surface finish indicators, optical and air gaging units, super magnifiers and precision gages, are used by the inspection team to assure Valvair's reputation for outstanding quality.

Specify Valvair components for the equipment you design, build or operate, to maintain your reputation for quality. For all the facts, write for Bulletin 59-SK, or call your nearby Bellows-Valvair Field Office. Address Bellows-Valvair, Akron 9, Ohio, Dept. AH-561.

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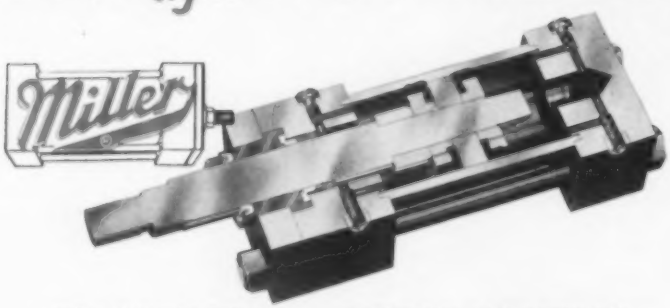
AKRON 9, OHIO

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

8171

FINEST *dynamic* CUP PACKINGS



Miller Hydraulic Cylinders . . . standardizing with MARSH 312 CUP PACKINGS FOR 15 YEARS . . . for use in nearly 100% PETROLEUM BASE FLUID APPLICATIONS

Mr. Frank Flick, President of Miller Fluid Power Division Flick-Reedy Corporation, has stated, "Applications of over 200,000,000 feet of piston travel with over 200,000,000 reversals have shown ***no measurable wear*** due to the inherent qualities of the leather."

Miller engineers say, "The self-regulating MARSH 312 Cup Seals result in minimum friction at all pressures . . . provide smooth, chatter-free operation . . . eliminate pumping losses and heat generation . . . permit closely regulated feeds even when heat changes oil viscosity."

Since 1946 Miller has selected Marsh (Resin Impregnated) Leather Cups when working with petroleum base fluids, as their standard.

If you would like information on how impregnated leather packings may answer your sealing problems — with air, gasoline, petroleum base fluids, synthetic fluids or water — WRITE, WIRE, OR PHONE

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Circle **114** on Reader Service Card

NEW PRODUCTS

Specifications: Capacities of 50 to 120 cu ft/min air. Lengths from

40⅞" to 95¼" overall. Cooling chamber is 4½" dia.—*Jas. A. Murphy & Co., Inc., Hamilton, Ohio.*

Circle **306** on Reader Service Card

IMPROVED TUBE FITTING

Bite-type fitting consists of body, nut, and ferrule. Modified ferrule is now snap-in type, held captive by the nut. Can be pushed in or

out but won't drop out. Larger opening gives nut clearance to slip around bends in tubing.
Designation: Intru-lok.—*Parker Fittings & Hose Div., Parker-Hannifin Corp., Cleveland.*

Circle **307** on Reader Service Card

SINGLE-ACTING AIR CYLINDER

Uses half the air volume required by conventional double-acting cylinders of equal size. Can be used as double-acting cylinder when needed. With face or clevis mounts. Conical spring simplifies return action and piping by allowing 3-way

Continued on page 84

YOUR BEST CHOICE IN FILTERS FOR ALL HYDRAULIC AND AIR-OPERATED EQUIPMENT

CFC Hydraulic Fluid Filters have been designed and installed on equipment that ranges all the way from a small plastic extruder to the hydraulic system in a missile silo. CFC Pneumatic Filters vary from a single tube high pressure unit on the nuclear-powered "George Washington" to a 50,000 CFM unit for a jet engine test stand.

CFC Filters are the choice of industry because they have been proven under critical operating conditions, because CFC has 25 years of specialized design engineering experience to rely on . . . in short because engineers can be sure that a CFC filter is the best filter available, at lowest cost.

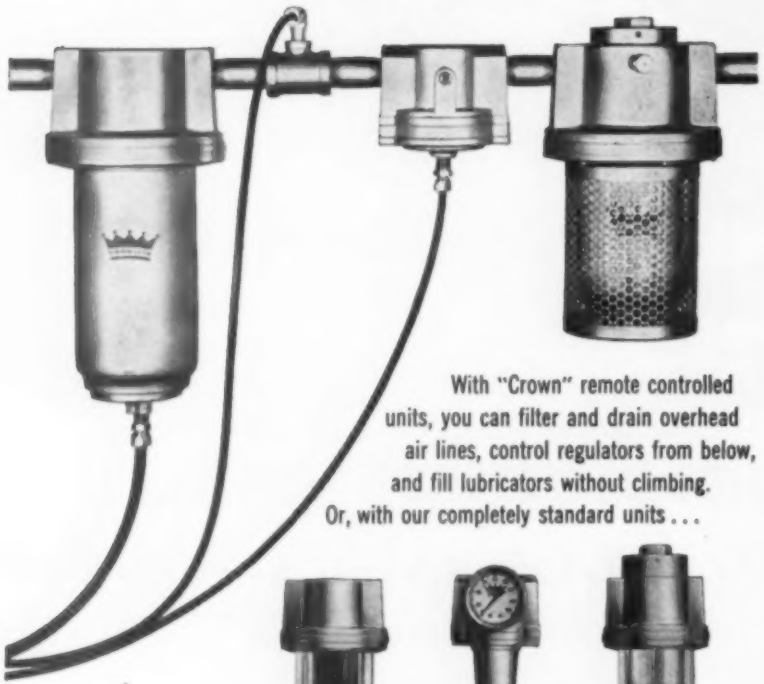
CFC

Stop in at the CFC booth #214 at the Design Engineering Show in Detroit and see what CFC offers you in pneumatic and hydraulic filters.

COMMERCIAL FILTERS CORPORATION
MELROSE 76, MASSACHUSETTS
PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

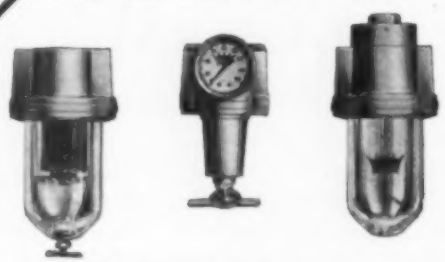
HANNIFIN *Crown*

delivers air the way you want it!



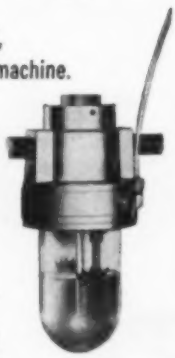
With "Crown" remote controlled units, you can filter and drain overhead air lines, control regulators from below, and fill lubricators without climbing.

Or, with our completely standard units . . .



. . . you can provide just the right amount of filtered, regulated and/or lubricated air right at your machine.

NEW! **PULSE-LUBE . . . for off-beat air flow**



If air flow is uphill or light or so infrequent that air-borne lubrication won't solve your problem, you can deliver oil just where you need it, in the exact amount you need, through a tiny flexible tube with new "Crown" Pulse-Lube . . .

All these "Crown" developments are detailed and described in a new, comprehensive "Crown" catalog (our Bulletin 0400-B1). We'll be happy to send you one.

PARKER HANNIFIN CORPORATION

HANNIFIN COMPANY

A DIVISION

545 South Wolf Road • Des Plaines, Illinois

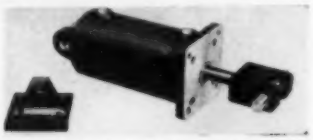
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS

EUROPEAN DIVISION • PARKER-HANNIFIN N.V. • SCHIPHOL • THE NETHERLANDS

Circle **79** on Reader Service Card

NEW PRODUCTS

instead of 4-way valve. Pressure tightening seals, Oilite rod car-



tridge, and full floating double-lip piston cup.

Specifications: In 2¼", 3", 4", and 5" bore sizes. 1", 2", or 3" strokes. *Mead Specialties Co., Chicago.*

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DRILL FEED

For production drilling, any number of holes, any angle. No time waste between operations. Positive, adjustable feed rate, and positioning. Micrometer marked thimble and graduated stop screw sets forward stroke to any position. Close center-to-center installation.

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Specifications: 250 psi at temperatures to 200 F. 200 psi at temper-

atures to 250 F.—*C. A. Norgren Co., Englewood, Colorado.*

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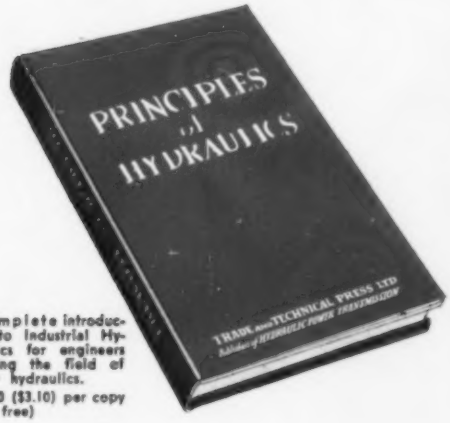

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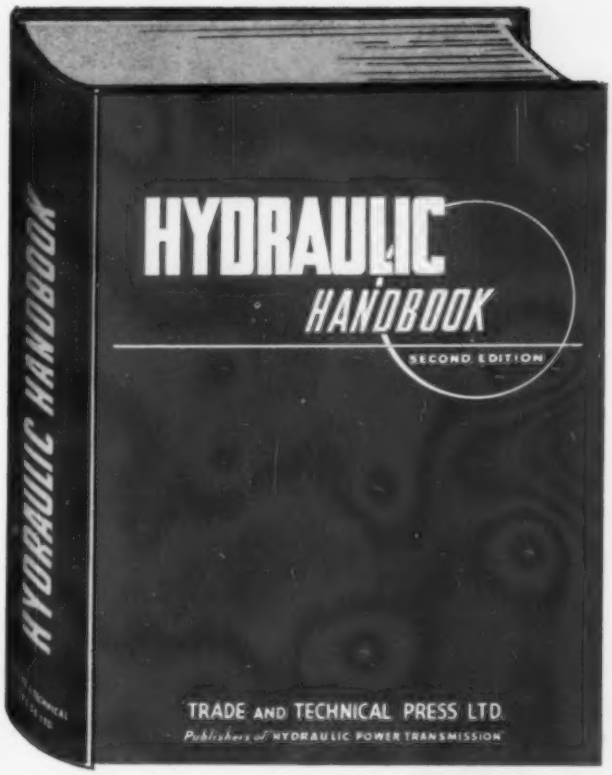

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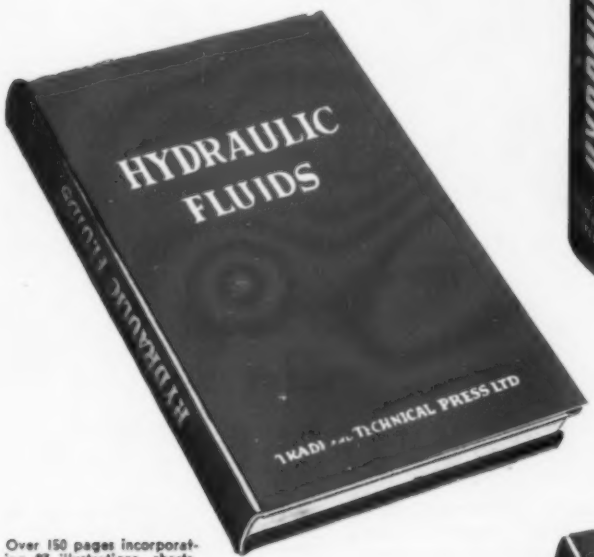

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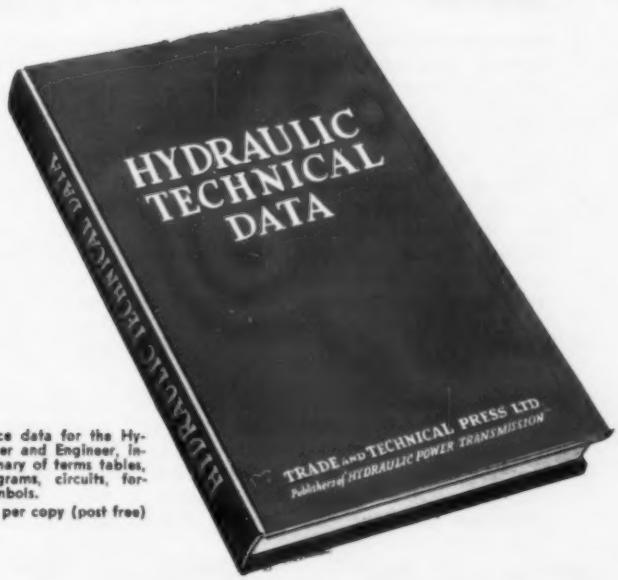

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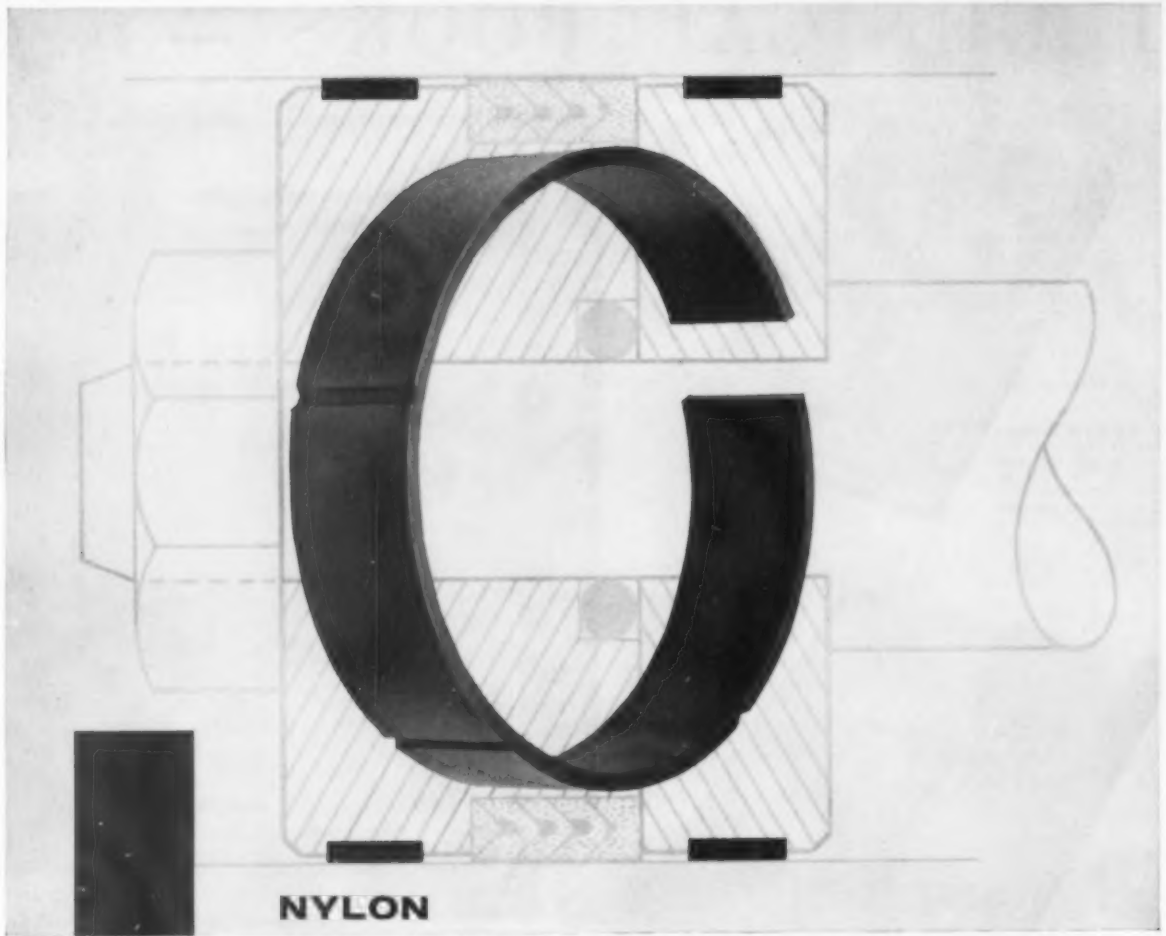

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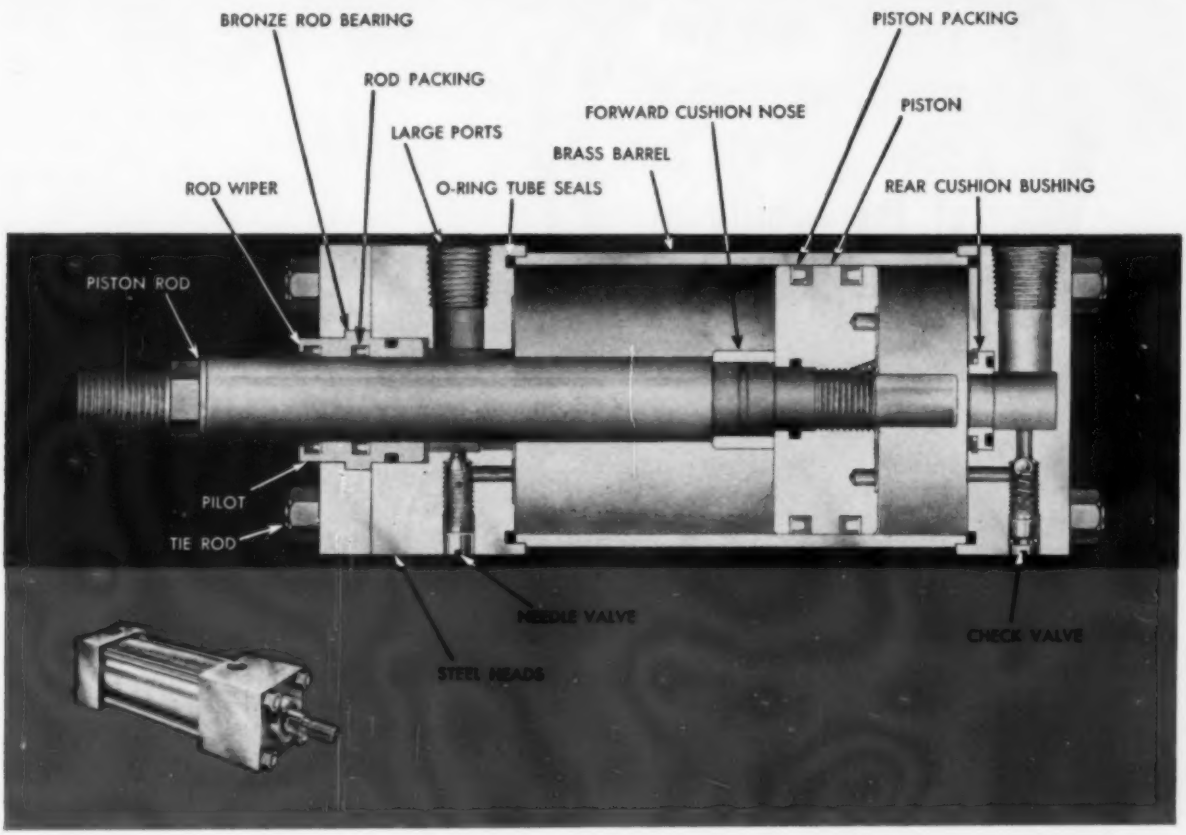
Continued on page 90

NEW O-M AIR CYLINDER

Series K•200 psi • 1½" to 14" Bores • Meets JIC Standards



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The O-M Series K cylinders have been designed for maximum operating efficiency, long life, and quick and easy maintenance.

For complete details write for Bulletin No. 115 in which all cylinders have been dimensioned in accordance with NFPA recommendations for your convenience.

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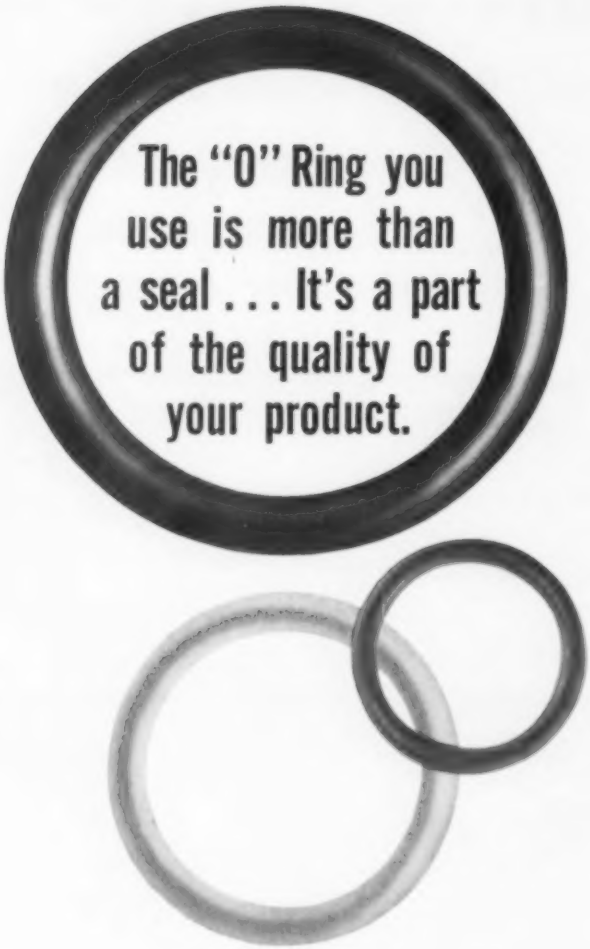

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sired specs. Can be molded, extruded, or formed.—*Plastics Div., Monsanto Chemical Co., Springfield, Mass.*

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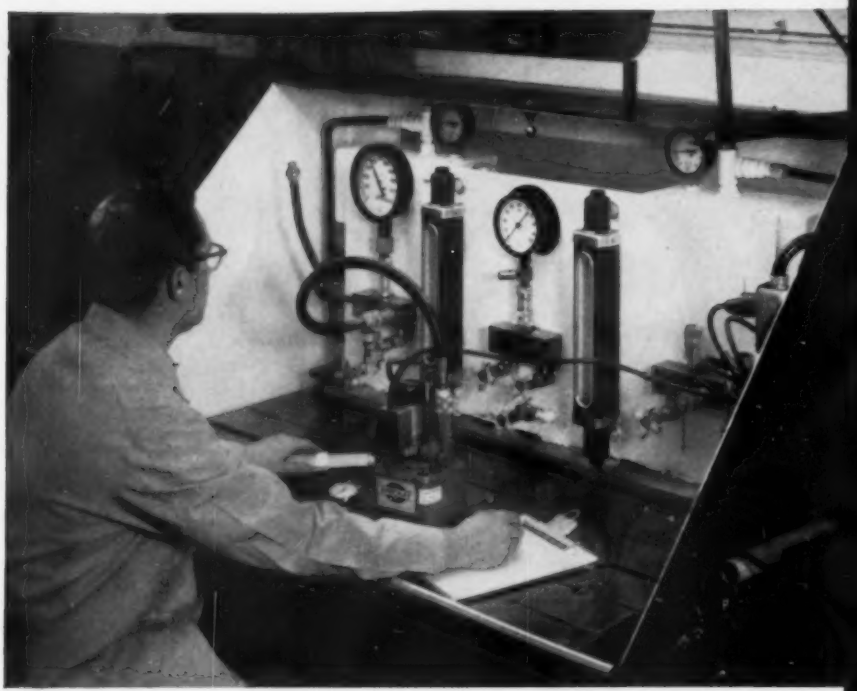
Practical solutions to many of today's high-pressure (10,000 psi) hydraulic problems begin right here



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Do you have a problem involving hydraulic pressures in the 10,000 psi area? Quite likely GREENLEE can be of help — either with our standard line of pumps and valves, or with adaptations engineered for your specific applications.

For many years GREENLEE has manufactured hydraulic equipment operating at high pressures. And as *specialists* in this field, our pump and valve engineers have worked closely with many other manufacturers on the development of a wide variety of mechanisms using 10,000 psi for plant, laboratory, or field use.

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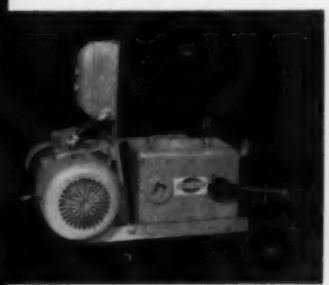
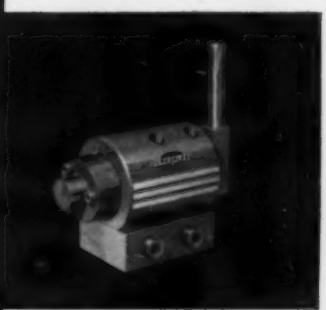
Specialists in high-pressure hydraulics GREENLEE

HIGH-PRESSURE, TWO-SPEED portable power pumps by Greenlee feature high volume, low pressure for fast-approach ram action and automatic change-over to low-volume, high-pressure drive. Lightweight series: 10,000 psi intermittent, 6,000 psi continuous. Heavy-duty series: 10,000 psi continuous. Portable—self-contained units. Choice of two-way or four-way valves.



HIGHER VOLUME, HIGH-PRESSURE Greenlee No. 797 power pump features extra-high-speed drive at high pressure. Up to 213 cu in. per minute at 10,000 psi. Pump, reservoir and control in one compact unit. Electric-motor or gasoline-engine driven. Choice of two-way or four-way valves. Mobile undercarriage optional.



GREENLEE HYDRAULIC VALVES for hydraulic systems up to 10,000 psi pressures. Two-way, three-way, four-way, flow control and free-flow metering types. (Four-way, spool type illustrated above.) Designed for integral or remote control of Greenlee pumps and for use on a wide variety of other hydraulic applications.

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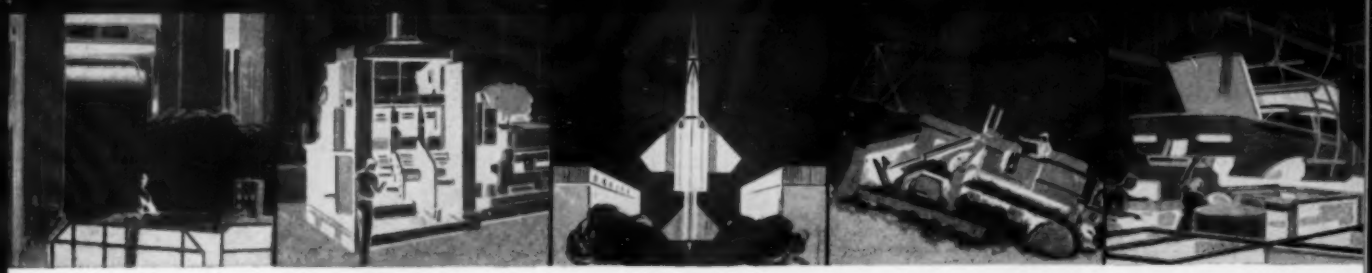

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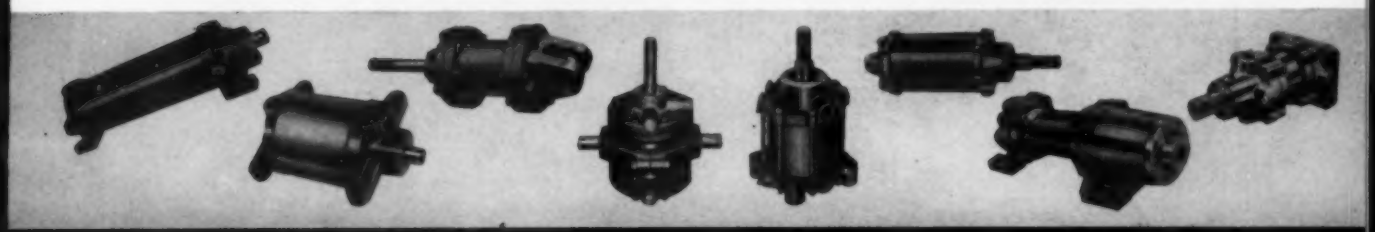
from the World's Widest Selection of Standard Cylinders



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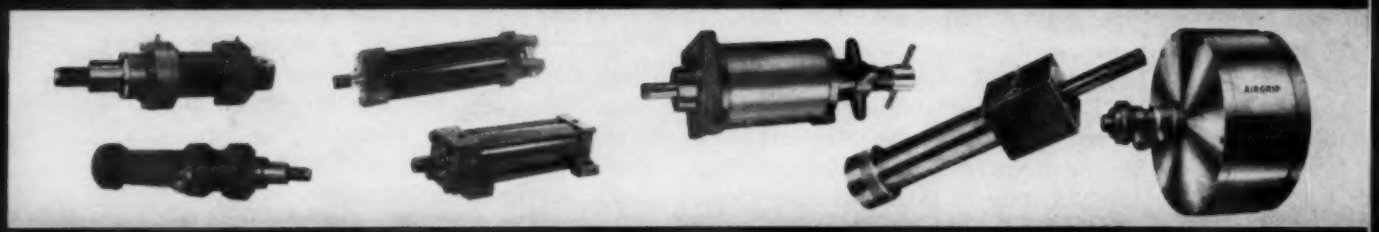

Only a few models could be shown above

This free catalog shows them all

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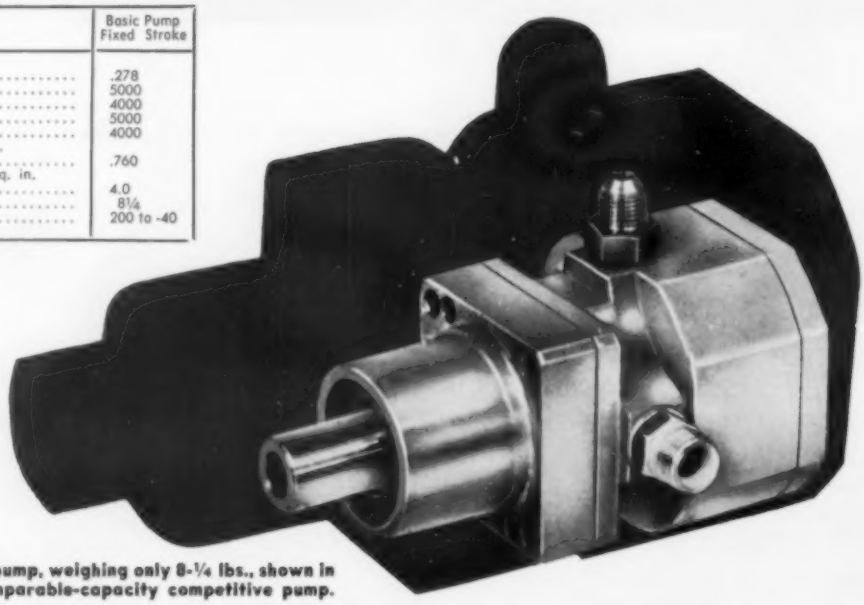
new LUCAS-ROTAX *industrial*

HYDRAULIC PUMPS AND MOTORS

offer the most advanced compact design

PUMP DETAIL	Basic Pump Fixed Stroke
Fluid displacement (cub. ins./rev.)	.278
Nominal working pressure (peak)	5000
(lb. per sq. in.) (continuous)	4000
Nominal speed (peak)	5000
(r.p.m.) (continuous)	4000
Input h.p. at 1,000 r.p.m. and 1,000 lb. per sq. in. differential	.760
Max. Torque (lb./ft.) per 1,000 lb. per sq. in. fluid pressure differential	4.0
Weight (lb.) Basic Pump	8¼
Operating temperature, ° F	200 to -40



LUCAS-ROTAX IA4 pump, weighing only 8-¼ lbs., shown in comparison with comparable-capacity competitive pump.

If you are interested in industrial hydraulic pumps or motors in the 1.5 to 108 g.p.m. range at pressures to 5000 p.s.i., you'll find more good design features in Lucas-Rotax pumps and motors than in any other quality line.

Lucas-Rotax industrial hydraulic pumps and motors are smaller and lighter than conventional units with low noise level in spite of high operating speeds. They offer fast response rate in pressure compensation and the low and medium capacity units can be operated from 2-pole motors to reduce the cost of the prime mover.

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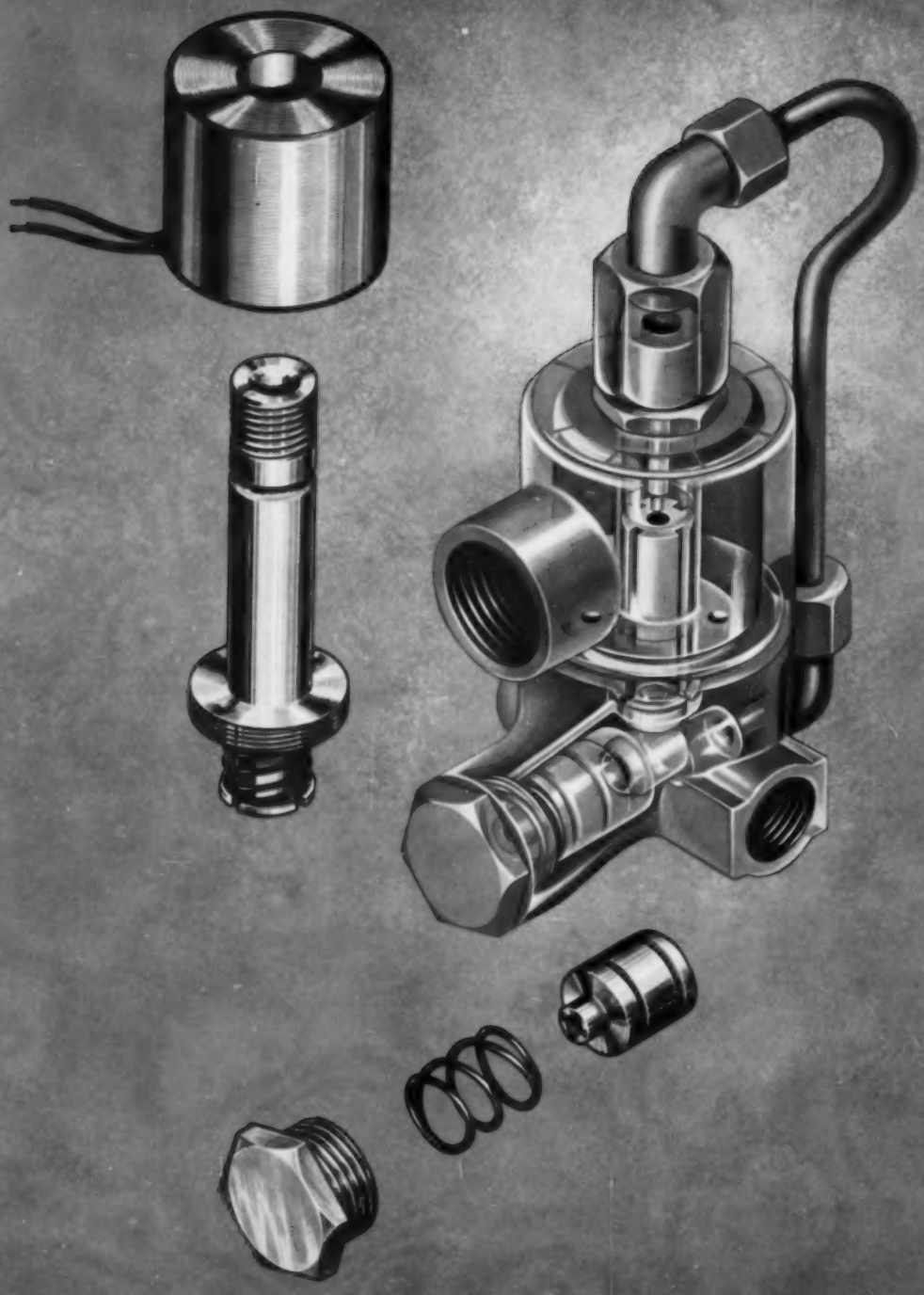
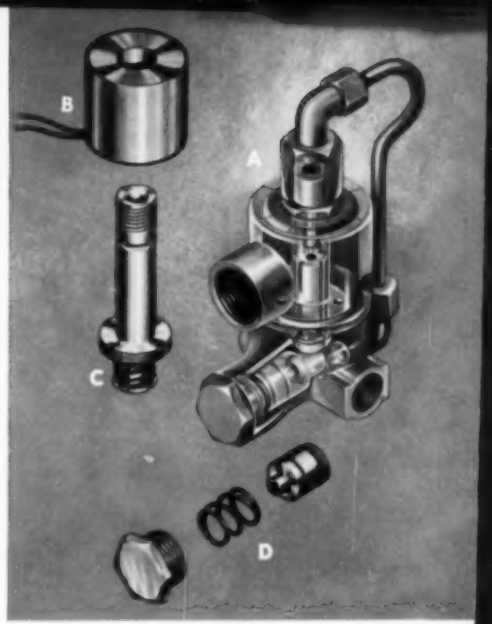


SKINNER 2-way Solenoid Valves

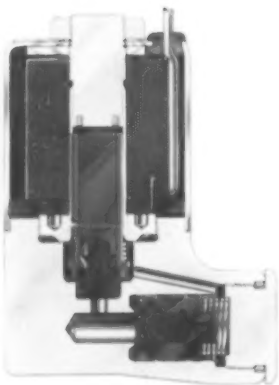
for high flow, high pressure applications

Here's how Skinner two-way valve design provides long lasting, trouble-free operation

- **Underwriters' Laboratories approved**
- **Stainless steel internal parts resist corrosion**
- **Forged naval brass body**
- **Famous Skinner V5 solenoid operator**
- **Well rounded main orifice and pilot seats**



A—Transparent view of normally open 2-way R type valve with piped pilot exhaust return
B—Coil C—Sleeve, plunger and spring assembly
D—Piston assembly with soft synthetic insert



NORMALLY CLOSED TYPE R2

When you have high-flow control problems at standard or high pressures the new Skinner two-way R series valves may be the answer. These pilot-operated solenoid valves are designed for use with air, oil, water, inert gases and other common media at operating pressure differentials of 5 up to 1250 PSI. They may be used for all types of control applications, such as: in high-pressure lifting, commercial laundry equipment, machinery, machine tooling, spraying, etc.

Skinner R series two-way valves have forged naval brass bodies to provide a dense metal structure and use a foolproof stainless steel piston with soft synthetic insert to open and seal the main orifice. Types are available normally open or normally closed, in standard and explosion-proof construction.

To make installation easy for every application, a wide choice of electrical housing options is available. These include JIC, AN connector, automotive terminals, etc. All housings can be rotated 360°. Manual override is also offered to permit manual opening of normally closed valves, or closing of normally open valves, in emergency.

Skinner R series valves may be used with all common voltages and frequencies and there are several coil types such as: varnished, molded waterproof, tropicalized and high temperature for specific applications.

The R series, illustrated here, is just one in a complete range of 2-, 3- and 4-way Skinner solenoid valves.

TWO-WAY R SERIES SPECIFICATIONS

Types	R2 XR2	R2H XR2H	R2H6	RP1 XRP1
Position	Normally closed	Normally closed	Normally closed	Normally open
Pipe Size (NPTF Dry Seal)	¼"	¼"	¼"	¼"
Orifice Size	¼"	¼"	¼"	¼"
Cv Factor	.758	.758	.758	.758
Operating Pressure Differential (PSI) Minimum	5	5	5	5
Maximum AC Service	200	1250	—	150
Maximum DC Service	200	500	1000	150
Leakage	Bubbletight	Bubbletight	Bubbletight	Bubbletight
Temperature Range (Ambient and Media)	Minus 40°F to plus 180°F	Minus 40°F to plus 180°F	Minus 40°F to plus 180°F	Minus 40°F to plus 180°F

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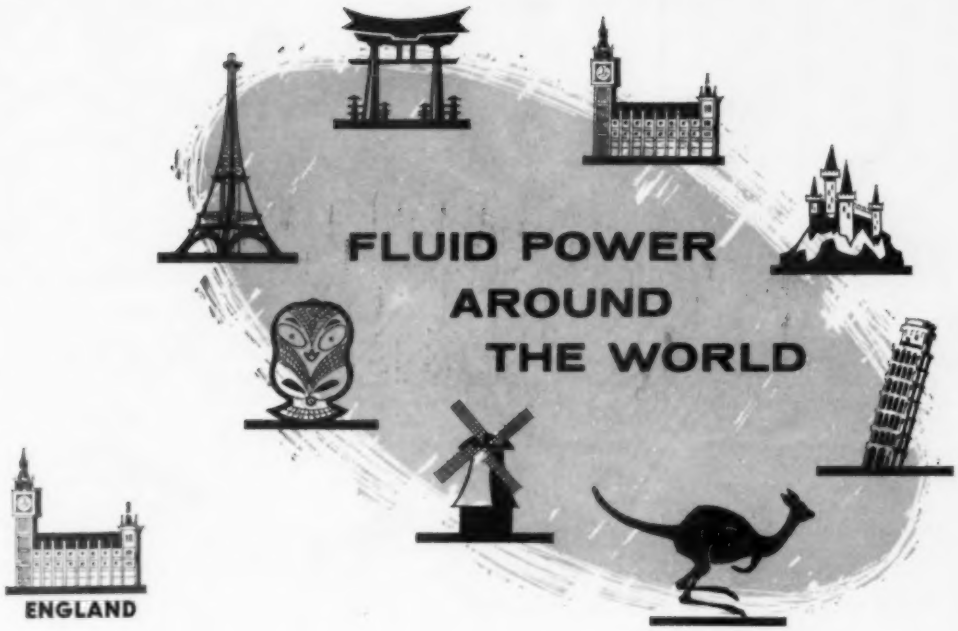


Hydraulic transfer mechanisms move boxes through radiation

• By R. A. PHILLIPS, *Electro-Hydraulics Ltd., Warrington, England*

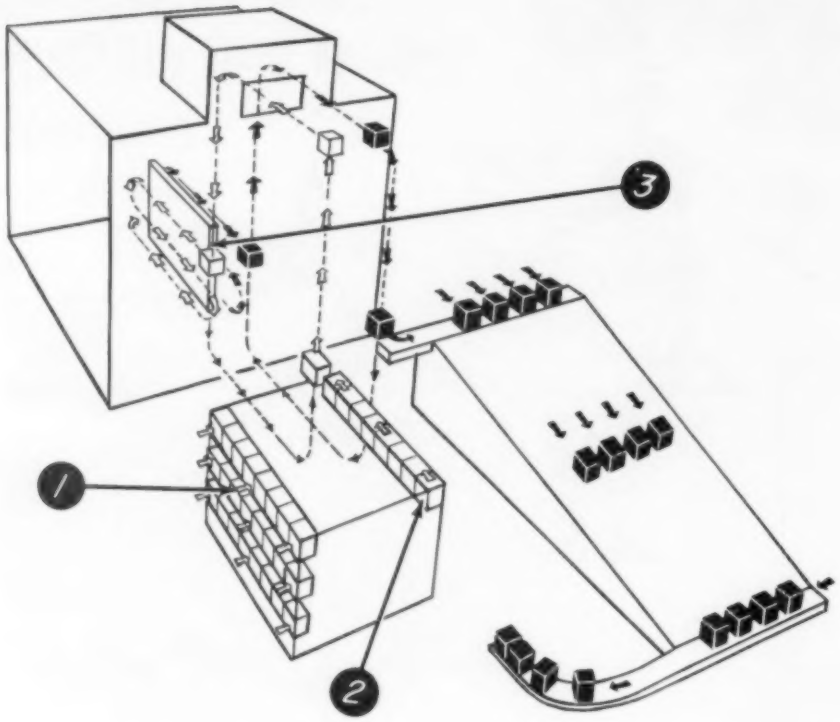
Engineers at Electro-Hydraulics, in England, worked out interesting hydraulic mechanisms to convey boxes weighing from 5 to 40 lb through gamma radiation for sterilizing tests. Speed reductions ranged up to 120:1.

BRITAIN'S Atomic Energy Authority needed an automatic transfer system to pass boxes through gamma radiation. No manual handling was allowed other than loading and unloading at the beginning and end. After the material is sterilized in the irradiation process, it is no longer radioactive, and can be unloaded safely by hand.

After thorough design analysis, it was decided to make the conveyor the heart of the machine, and sequence all movements either from the hydraulic conveyor drive, or limit switches tripped by the boxes themselves. This would make speed and operation of the entire system dependent on conveyor speed which would range from 0.9 to 108 in./min.

Text continued on page 100

HYDRAULIC TRANSFER MECHANISMS



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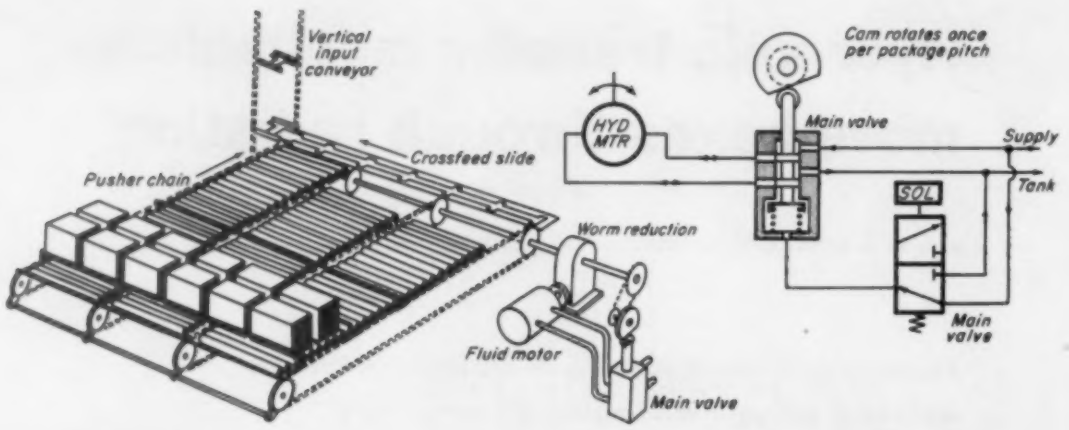


CAM CONTROLS TRANSFER SPEED

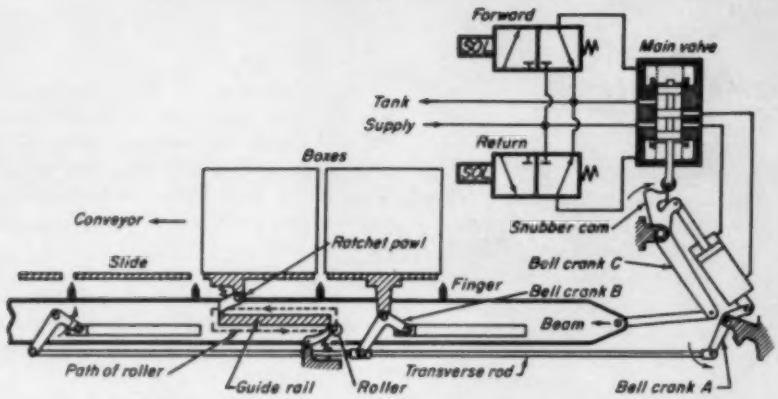
Boxes are loaded manually on the input storage shelves. From there, a hydraulic chain drive moves the boxes, a row at the time, onto a crossfeed slide which feeds them onto the vertical conveyor trays. When a valve solenoid is energized in the hydraulic pusher chain drive, oil exhausts from the bottom chamber of the main valve. This allows system pressure in the top chamber to shift the spool and connect fluid to the motor.

The solenoid valve only starts motion, and is then de-energized. The cam takes over and provides a mechanical hold-on. As the cam rotates to its final position, it lets the main valve close to stop the motor. Overshoot of the chain causes the main valve to reverse. Fluid flows through the solenoid valve which acts as a restrictor to correct overshoot slowly.

Cam profile is designed to close the main valve gradually so that the pusher chain slows down each time a row of boxes nears the crossfeed. One row of boxes is pushed onto the crossfeed slide for each revolution of the cam.

This design was decided upon because no movement of the main valve could be tolerated when the equipment is switched on or off by starting system pumps. The main valve in its static position must be de-energized, and must be pressure balanced and held closed by a spring.

2



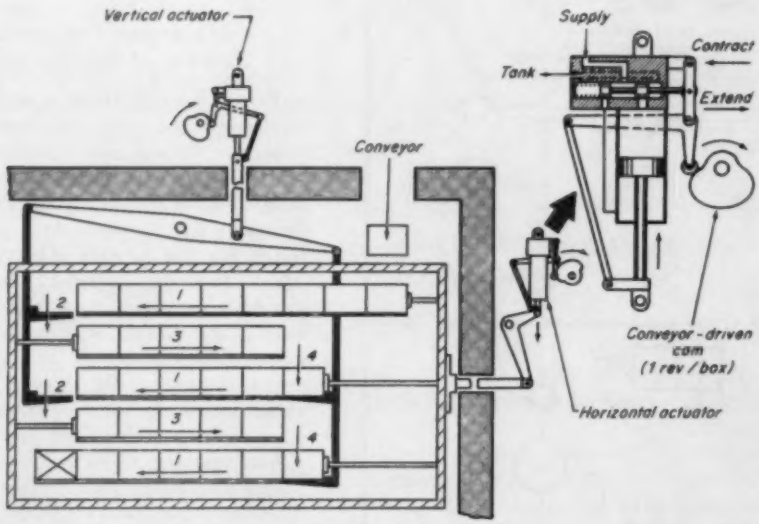
SHUTTLE SYNCHRONIZED TO CONVEYOR ELECTRICALLY

After a row of boxes is lined up with the vertical conveyor, the boxes are transferred one at a time onto it. When a conveyor tray is in line with the row of boxes, a limit switch energizes the valve's *forward* solenoid. Oil exhaust from the cylinder head end, and pressure fluid on the piston's rod end retracts it.

As the cylinder retracts, bell-crank *A* at the bottom of the cylinder moves the transverse rod right, raising the beam by rotating bell-crank *B*. Each finger engages a box. As the cylinder continues to retract, the clockwise rotation of bell-crank *C* pushes the beam and boxes to the left. The fixed guide around which the roller runs prevents the finger beam from rising or falling except at the extreme ends of travel. Ratchet pawls insure correct motion.

At the end of the stroke, the snubber cam gradually pushes the valve spool back to neutral. As forward movement is completed, the *forward* solenoid is de-energized. The *return* solenoid is then energized, shifting the main valve spool and pressurizing both sides of the cylinder causing it to extend. This shuttling, reciprocating action of the crossfeed is synchronized to deposit a box on each passing tray of the vertical conveyor.

3



RECIPROCATING MOTION COMBINES WITH LIFTING & LOWERING

Once the boxes are inside the irradiation cell, they are shuffled and zig-zagged back and forth, and up and down past the irradiation source. Horizontal cylinders reciprocate the rows of boxes to and fro. Vertical cylinders alternately rock the row of boxes up and down, each time transferring a box to the next lower or higher level depending whether the box is on its incoming, or out-going course of the radiation cycle. The actuators are located outside the cell, and the shuffling is done by push-rods passing through the concrete wall. Roller tracks minimize friction and enable the pusher to move a whole row of boxes at a time.

To avoid boxes from overrunning, acceleration and deceleration are limited to less than 0.1 g in the horizontal plane and 0.5 g in the vertical plane. Regular hydraulic snubbers could not meet these requirements because of the distances the boxes had to be moved, the variable weights of the boxes, and the various exposure times. A mechanical cam, synchronized with the conveyor drive, was used to meet the necessary specifications. Because of the large forces involved, a hydraulic servo was installed between the cam and the cell mechanism to repeat and magnify all cam movements.

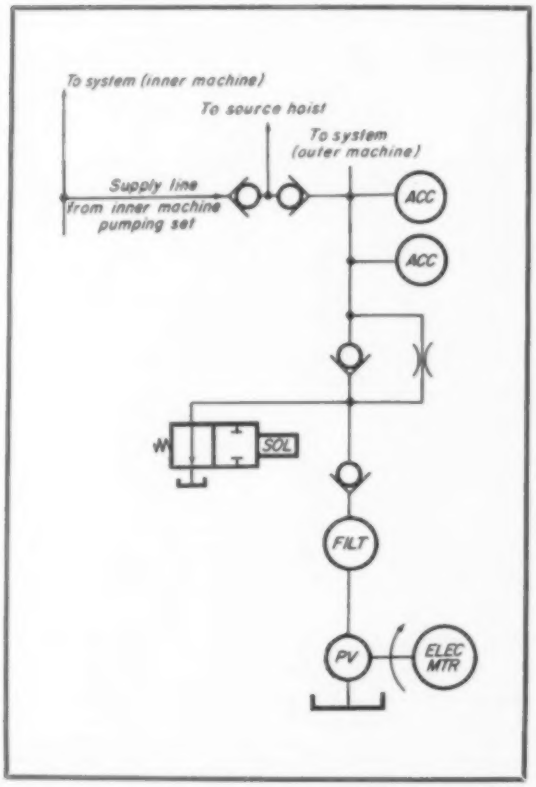
This was done with a variable speed, hydraulic transmission which gives wide speed variations and holds any set speed accurately. Requirements for a speed range of 120:1 and speed fluctuations limited to 5% were more than could be handled by a hydraulic drive alone. For this reason, a mechanical, 2-speed gear change was installed between the hydraulic motor and the conveyor drive.

This was necessary because speed fluctuations in a hydraulic transmission are often caused by hydraulic slip which is a function of oil temperature (viscosity) and pressure. Speed fluctuations depend on output torque (which causes pressure) rather than output speed. Oversize units helped to keep temperatures and pressure down. If the conveyor running torque fluctuates by a given amount, it causes an output speed fluctuation of a given number of rpm. At lower set values of output speed, this represents a higher percentage speed fluctuation than can be tolerated.

If, as a result, a hydraulic transmission can produce a speed range of only 6:1, then a mechanical 6:1 gear change installed between the hydraulic motor output and the conveyor sprocket would give an overall conveyor speed range of 36:1. Hydraulic motor speed range in low gear will be greater than 6:1 because the gear change has reduced the torque on the hydraulic motor, and therefore torque variation and slip. Thus in low gear, hydraulic transmission speed range could safely be made 20:1, giving an overall speed range of 120:1.

Each of the two conveyor drives in this system is driven by a variable-speed hydraulic motor supplied by a variable-delivery pump to control speed. Each system has a separate pumping unit to power all other transfer motions.

To insure correct radiation dosage to each box, even in case of shut-down, the radiation source is raised or lowered quickly and micro-switches prevent the conveyor motor from starting unless the source is fully raised.



PUMPING CIRCUIT for each system is similar but independent. Output from either inner or outer machine can actuate source hoist.

• **Safety Features**—Human exposure to gamma radiation is extremely dangerous. These safety features were incorporated into the system to safeguard all personnel:

- In case of shut-down or emergency, a hoist cylinder automatically lowers the radiation source into its storage water tank.
- When system pressure drops below 750 psi, a limit switch drops the source into the water tank and shuts down the plant.
- A limit switch prevents the hoist from raising the radiation source until system pressure builds up to 1000 psi. This insures adequate operating pressure before irradiation starts.
- When the system is started up again, the process continues from where it left off, thus avoiding over or under radiation exposure.

• **Power System Design**—A variable-delivery, pressure-compensated pump was selected as the best means to provide variable speed characteristics. System pressure applied to a piston, linked to the pump's swashplate, controls output volume. At maximum pressure, delivery drops to zero. At top operating speed, the system requires 8.5 gpm at 800 psi.

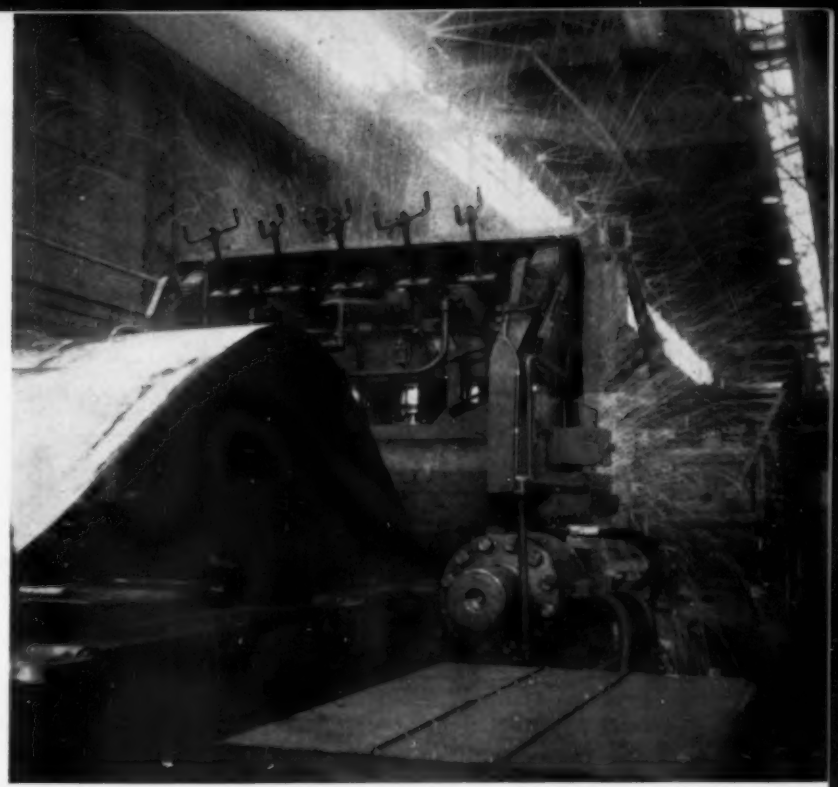
Two 10-gallon, rubber-bag accumulators are pressurized to 600 psi to take care of system fluctuations. When the machine is shut down, the accumulators slowly discharge to tank through a 1/16-in. orifice. If electrical power fails, there is enough reserve fluid under pressure in the accumulators to keep the irradiation servos working until the conveyor has stopped.

Tank capacity is 70 gallons. A 20-micron, sintered bronze filter is connected in the pump output line. Both conveyor drives have similar but independent hydraulic systems. Pumps are connected to the radiation source hoist control through check valves so that either or both can raise or lower the source in an emergency. ▼▼▼

The radiation machine was built for the United Kingdom, Atomic Energy Authority, Technological Irradiation Laboratories, Wantage, England. The project was carried out jointly by Rubery, Owen & Co., Ltd., Darlaston and Electro-Hydraulics Ltd., Warrington in collaboration with the Engineering Division, Atomic Energy Research Establishment at Harwell.

JAPAN

Do you modify commercially available components when you can't find exactly what you want, or do you design new ones? Builders of this high speed flash welder did both. They converted a standard manual 4-way valve into an accurate servo control valve. They also designed and built special double cylinders for fast clamping.



Developing hydraulic controls for a high speed welder

• By S. MIYATA, *Executive Director of Engineering, Tokyo Keiki Seizosho Co., Ltd., Tokyo, Japan, Subsidiary of Vickers, Inc., Division of Sperry Rand Corp.*

FLASH welding the ends of steel strips in a continuous strip pickling line requires high speed and close control. One strip is clamped in a stationary platen while the strip following it is clamped in a moveable platen. Hydraulic cylinders extend the moveable platen closing the gap between the strips. Electric current flowing across the gap creates an arc heating the ends of the strips. When the gap reduces to a preset minimum, full system oil output flows to the platen cylinders welding the strips together.

Type of alloy and thickness of the strip dictate the speed at which the strips move together for welding. This speed is critical and must be closely controlled to produce a good weld.

One method of control would be an electrohydraulic servo system. After examining the cost of an electrohydraulic servo valve and its associated control equipment, engineers at Tokyo Keiki Seizosho Co., Ltd. (designers of the hydraulic system) looked for something less expensive that would give the required accuracy.

They decided that a mechanically actuated servo valve using a feedback linkage would give the accuracy they needed at a reasonable cost.

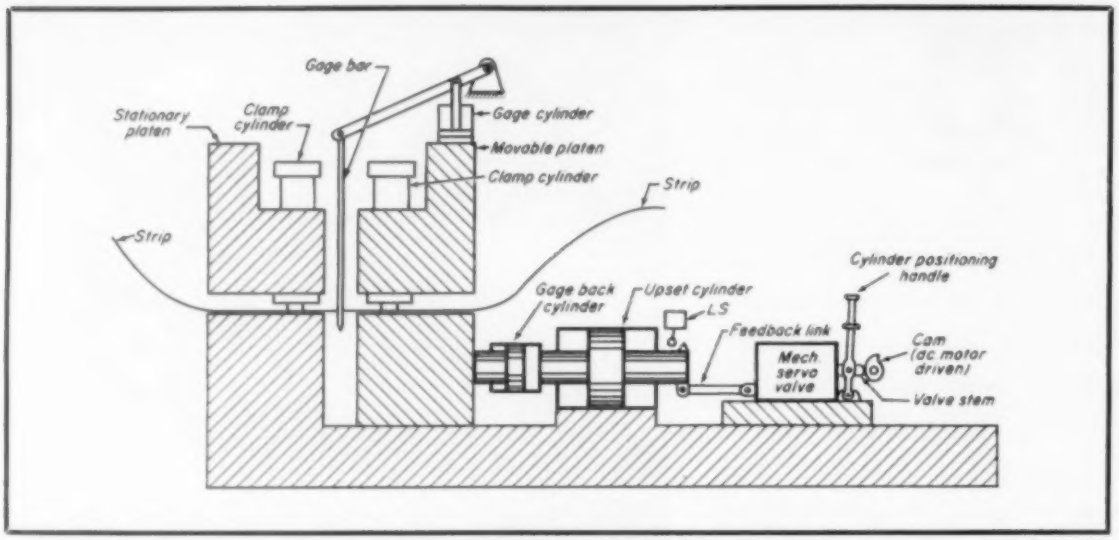
• **Modified Standard Valve**—Standard 4-way, closed-center, directional control valves generally have too wide a dead band at neutral to give close servo control. Also their manufacturing tolerances are greater than those required for servo valves. However, with some alterations, designers of the welder converted a standard 4-way valve to a servo valve for controlling the platen cylinders.

The valve selected was a $\frac{3}{4}$ in., manually-operated, closed-center, 4-way valve. The valve body was fitted with a steel sleeve so that the cylinder ports could be accurately positioned. Spool lands were ground to a mirror finish, and guide lands were placed at each end of the spool to reduce spool drag.

• **Fluid Motor Calibrates Valve**—Before the valve was installed it had to be tested and calibrated.

A test circuit was made using a vane type fluid motor of known displacement as a flow meter and a dial indicator showing spool movement.

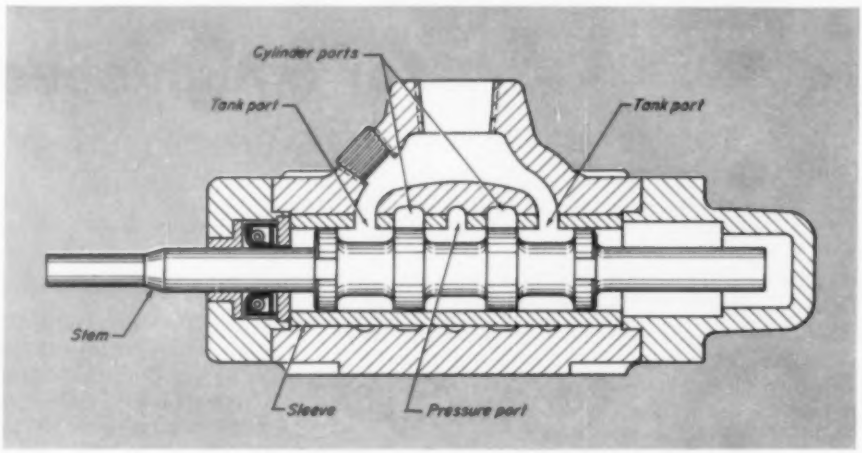
Here's how it was done. A pump, relief valve, and a



FLASH WELDER for continuous strip line is hydraulically actuated. A gage bar lowers between the strips as they are fed into the welder. It fixes the gap between the strips before welding. The clamp cylinders then extend holding the strips in the moveable and stationary platen. The short-stroke, gage back cylinder retracts allowing the gage bar to be lifted from between the strips. The moveable platen is advanced an amount equal to the stroke of the gage back cylinder. This is done with the cylinder positioning handle connected to the servo valve stem.

During welding, the upset cylinder moves forward at a speed controlled by the mechanical servo valve. Servo valve displacement is controlled by a cam driven by a dc motor. Platen position feeds back to the servo valve through the feedback link.

A limit switch near the end of the upset cylinder's stroke energizes a solenoid pilot valve directing full pump output to the cylinder to complete the weld.



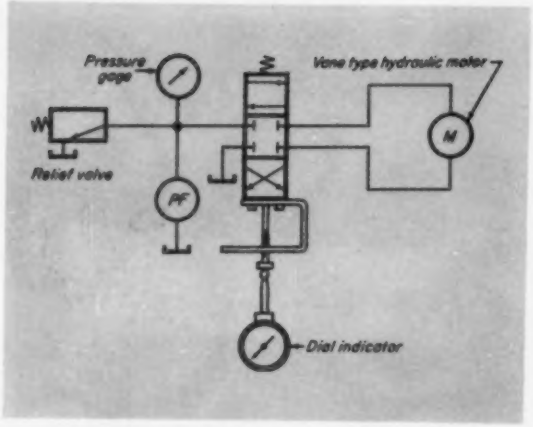
CYLINDER PORTS are accurately positioned on a steel sleeve inserted into the body of a standard 4-way valve. Adding guides at each end of the spool and grinding the lands to a mirror finish made the valve suitable for accurate servo control.

pressure gage were installed in the pressure line to the servo valve being tested. A vane type fluid motor was connected across the valve's cylinder ports. A dial indicator mounted at the end of the valve stem accurately indicated spool movement.

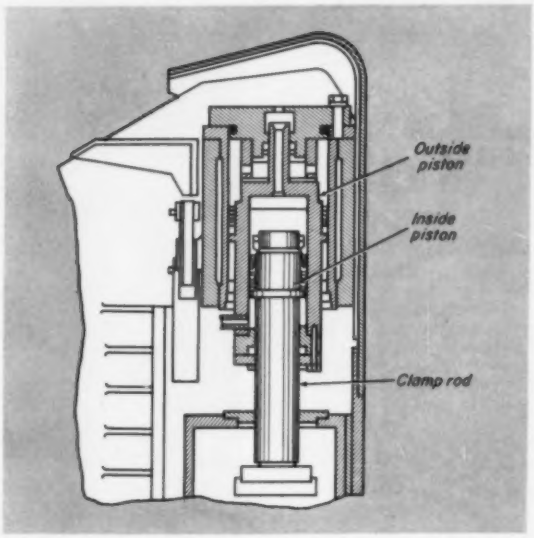
Tests made at 150 psi and 300 psi relief valve setting showed the valve was well within the sensitivity requirements for the welder. Spool dead band at neutral was ±.0004 in. Difference in flow rate through the cylinder ports at equivalent spool displacement was less than 0.3 gpm. at 300 psi. The valve delivered 15 gpm with a spool shift of only .04 in.

● **Double Cylinders Speed Clamping**—A loop is made in the strip at the OUT end of the welder just previous to welding. The entire welding operation must be completed before the continuously moving line beyond the welder uses up this loop.

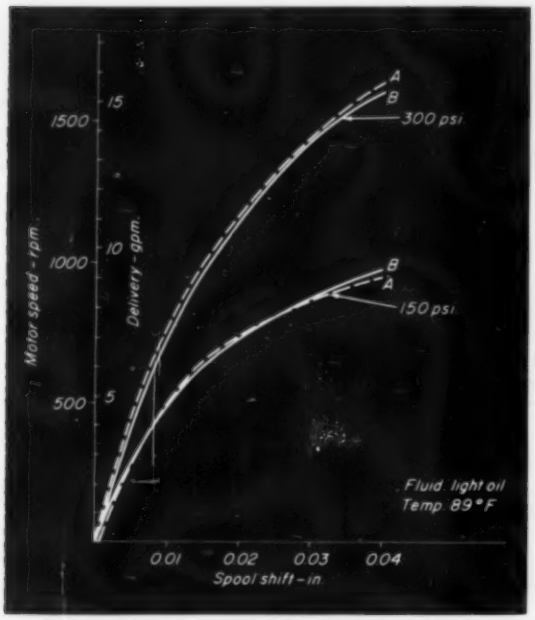
Special double-cylinder clamps were designed and built to speed clamping the strip in both the stationary and moveable platens. The clamps required a high force to prevent the sheet from slipping during upset (the final stage of welding when the strips are forced



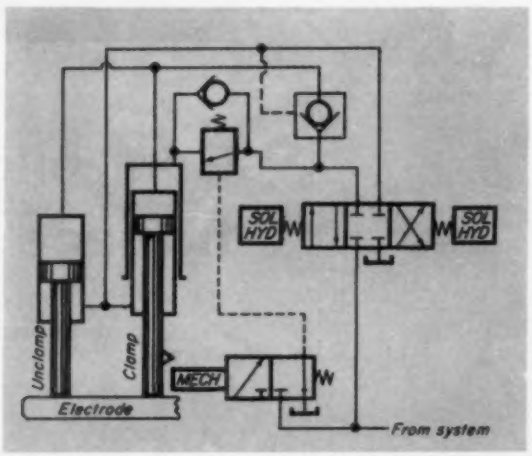
TEST CIRCUIT uses a fluid motor for indicating flow. Motor displacement times its rpm gives flow through the valve. Dial indicator records movement of valve spool.



DOUBLE CYLINDER speeds clamping of strips. Small inside piston extends first. Larger outside cylinder provides high clamping force.



VALVE DELIVERY increases rapidly for small spool movements. Maximum flow variance to the two cylinder ports with the spool equally displaced on either side of center is 0.3 gpm.



SEQUENCE CIRCUIT extends the inside cylinder first. Cam actuated valve directs pilot pressure to sequence valve extending the outside cylinder. Pilot check valve holds fluid in inside cylinder during clamping. Unclamp cylinders retract the electrode which also retracts the outside cylinder.

together). They also assure that the electrodes are held tightly against the strip preventing excess heat from the electrical current.

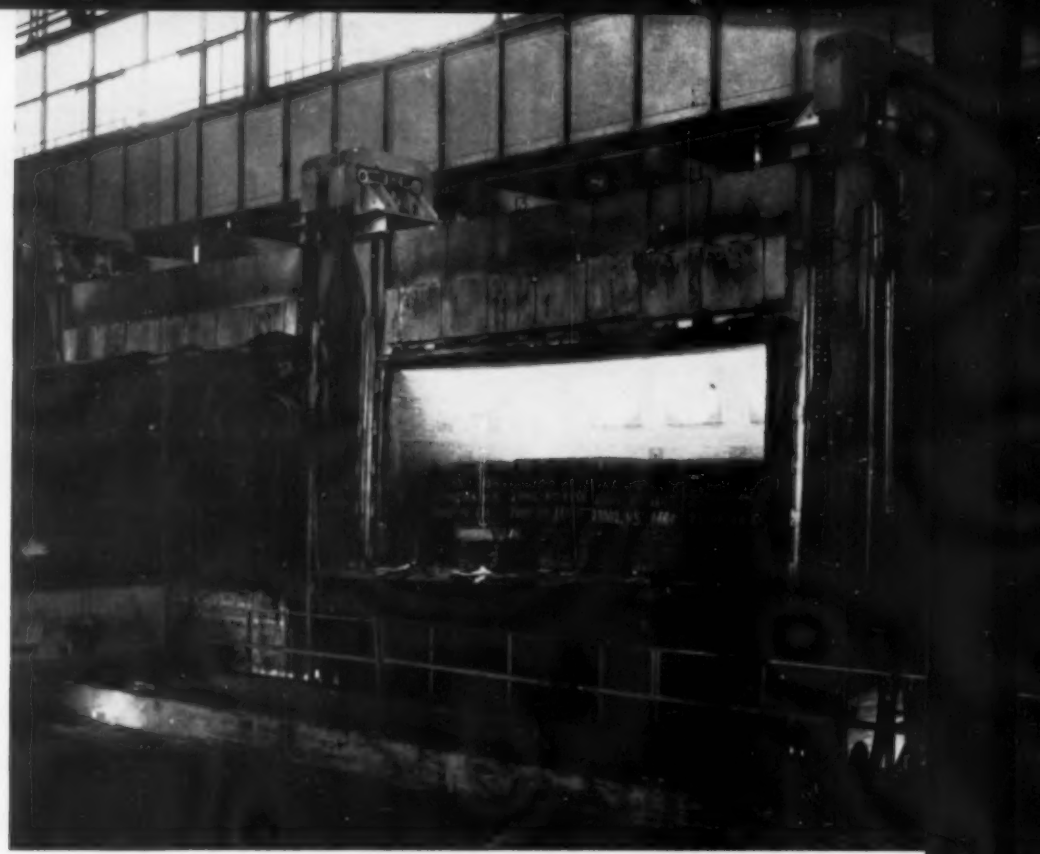
Double cylinders were designed to reduce clamping time and provide high clamping force. They have a double-acting inside cylinder which telescopes into a single-acting outside cylinder.

When the control valve shifts it directs pressure fluid to the inside cylinders which extend until they reach the strip. At this point, a cam on the inside cylinder's rod actuates a valve which directs pressure fluid to the pilot on a sequence valve. The sequence valve opens and directs pressure fluid to the outside cylinder. A pilot check valve holds fluid in the inside cylinder during clamping.

When the control valve shifts to raise the clamps, fluid is applied to the rod ends of the inside cylinders and the unclamp cylinders. This pressure is also applied to the pilot of the pilot check valve. The inside cylinders retract and the unclamp cylinders retract the outside cylinders.

▼▼▼

HOLLAND



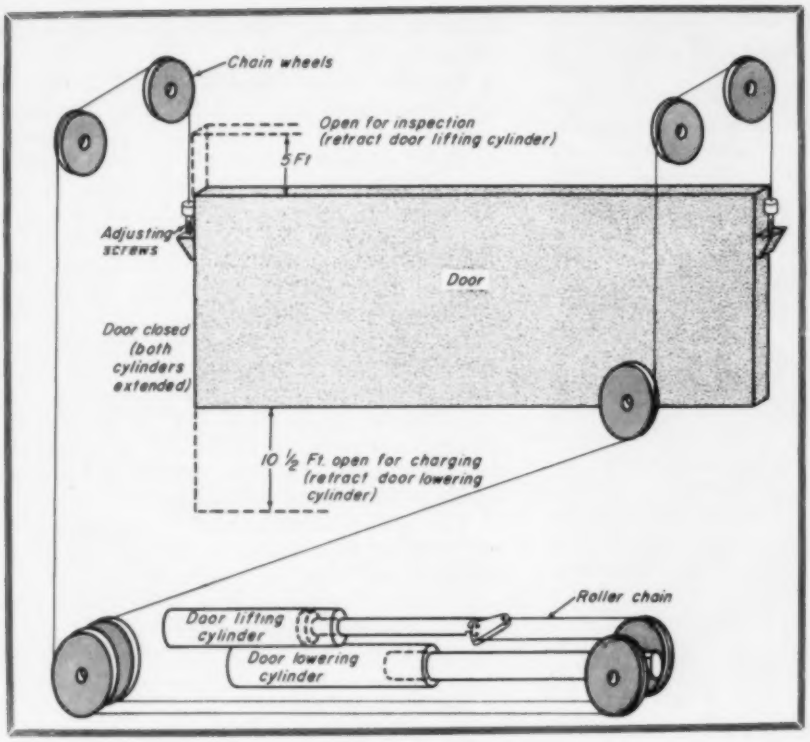
Cam/pilot valves give smooth furnace door operation

• By F. D. STUYVENBERG, *Hydraudyne, Boxtel, Holland*

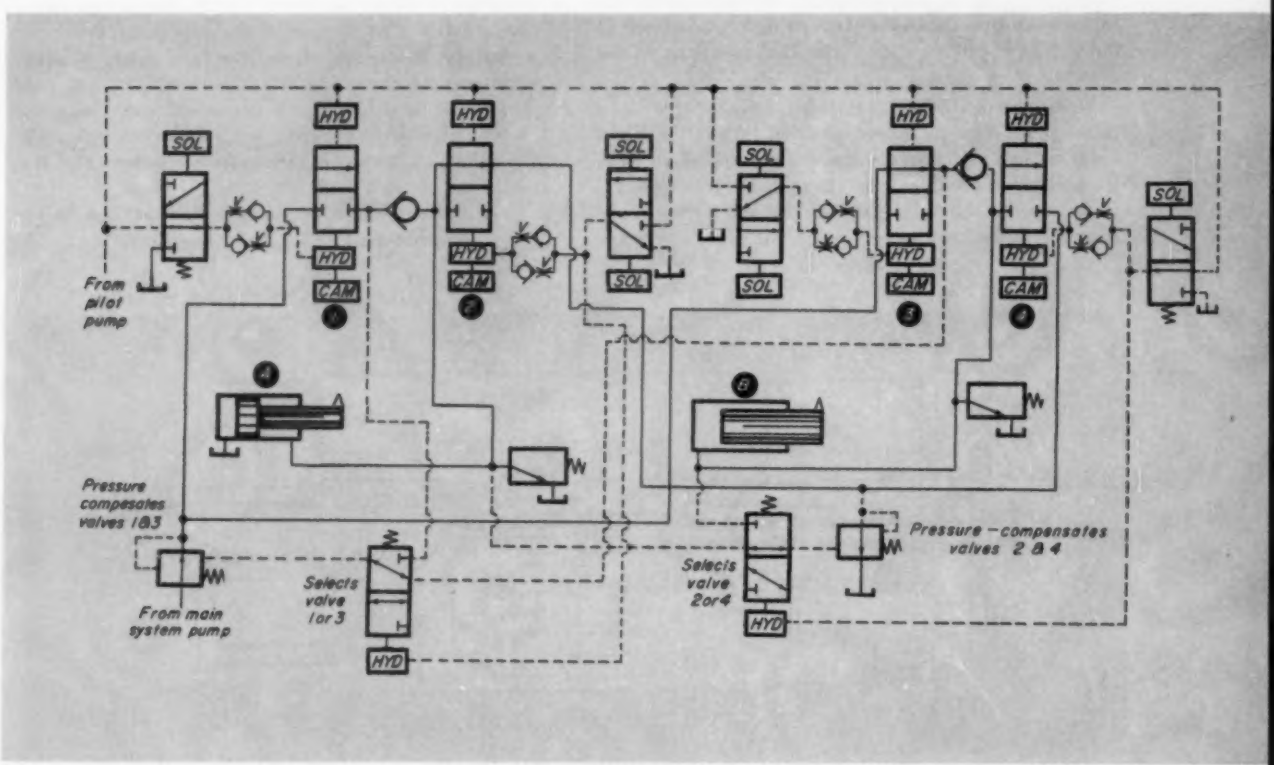
Heavy, brick lined furnace doors must be started and stopped carefully. Any sudden change in motion or jarring of the doors may damage the brickwork. These doors, which weigh close to 25 tons, are controlled by spool valves, opened by hydraulic pilot pressure and closed by a cam. The spools are designed to give a linear increase or decrease in flow with constant valve actuation speed.

WHEN one of the large steel mills in Holland (Koninklijke Nederlandsche Hoogovens en Staalfabrieken) designed new furnaces to handle heavier slabs, they had to devise a method of quickly opening and closing the furnace doors. The doors have to move fast to prevent heat loss from the furnace operating at 2400 F, and they have to start and stop gradually to avoid loosening their brick lining. Reliability is important because the entire production of the mill depends on getting the slabs in and out of the furnace quickly. To meet these requirements with a safe and efficient system, Hydraudyne engineers selected accurately controlled hydraulic cylinders to actuate the doors.

• **Central Power Supply**—There are five furnaces, each having a large sliding door which must be raised and lowered. After considering cost and available space, Hydraudyne engineers decided on a central hydraulic power source rather than individual pumps for



TWO SINGLE-ACTING CYLINDERS raise and lower the furnace door. Retracting the door-lifting cylinder raises the door for inspection and cleaning. Retracting the door-lowering cylinder lowers the door for loading and unloading the furnace.



TWO-WAY VALVES are normally held open by pilot pressure to the smaller of two actuator areas. They are closed by applying pilot pressure to the larger actuator. A deceleration cam also actuates the valves at the end of the cylinders' stroke. Pressure reducing valves assure a constant pressure drop across the 2-way valves. This pressure-compensates the 2-way valves and assures a uniform flow through them.

each furnace. A 300-gal piston accumulator is used at the central power source to reduce horsepower requirements of the pumps and provide a source of emergency hydraulic power. The accumulator is charged by two, axial piston pumps, each delivering 19.8 gpm at 2000 psi. Each pump is equipped with an integral gear pump providing low pressure fluid for a separate pilot circuit. Each pump is driven by a 30-hp, electric motor. Using two pumps and motors provides greater reliability. If one power unit fails, the system will operate satisfactorily from the other unit. Power consumption is kept low by unloading the pumps when the accumulator is charged.

• **Two Cylinders Move Doors**—To open the furnace fully, its door must be lowered 10½ ft. This movement is called *operating movement* and is done by retracting a ram type cylinder having a bore of 12¾ in. and a stroke of 5 ft. 9 in. In another movement, the door is raised 5 ft. from its closed position for inspecting and cleaning the furnace floor. This is called *inspection movement* and is done by retracting a 10¼ in. bore, 5 ft. stroke, piston type cylinder. With both cylinders extended the door is closed.

The door is supported with two roller chains which extend over chain wheels at the top of the furnace. From there the chains extend to the bottom of the furnace, around the lower chain wheels, and attach to the rod of the door lifting cylinder as shown in the drawing.

When the door-lifting cylinder retracts, the door raises 5 ft. from its closed position. When the door-lowering cylinder retracts, the door moves down 11½ ft., a distance equal to twice the cylinder's stroke. This is because the chain is fixed at one end to the door-lifting cylinder, and passes over chain wheels attached to the door-lowering cylinder's piston rod before it connects to the furnace door.

• **Cylinder Speed Control**—Special, 2-way valves limit acceleration and deceleration to 3 ft/sec². A contour, machined on the valve spool gives a linear increase or decrease in flow when the spool moves at a constant speed. A hydraulic actuator opens the valve. To assure constant spool velocity, a variable flow control valve meters fluid to and from the actuator. A cam closes the valve at the end of the cylinder's stroke, bringing the cylinder slowly to a stop. Deceleration is determined by the shape and location of the cam.

The valve's hydraulic actuator has differential areas; the smaller area is always exposed to pilot pressure. To close the valve, pilot fluid is metered to the larger area. The valve is opened by metering fluid out of the larger actuator area, or by the cam at the end of the cylinder's stroke. The cam also provides a positive means of decelerating the cylinder.

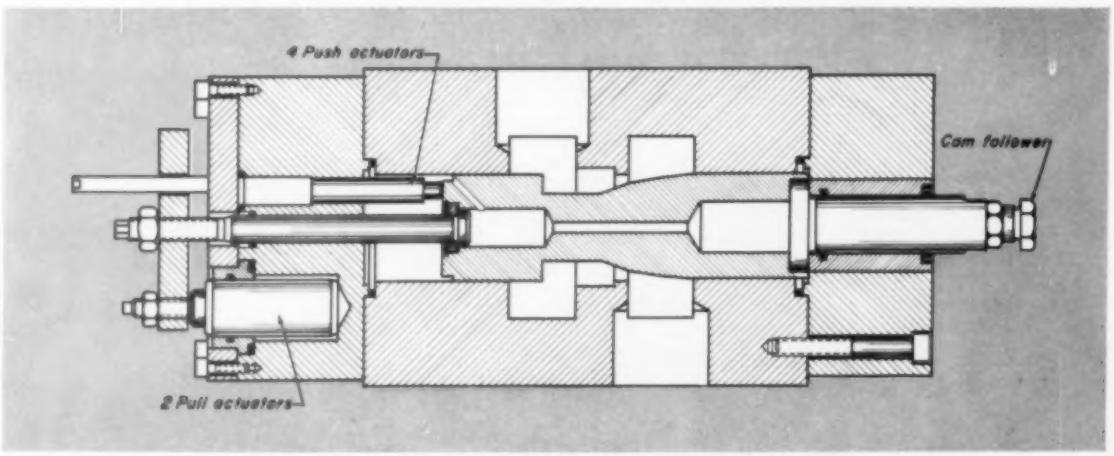
Two of these valves are used to control each cylinder. One regulates flow *to* the cylinder and the other regulates flow *from* the cylinder to tank.

Pressure reducing valves in series with the 2-way valves pressure compensates them so they pass constant flow regardless of pressure. The pressure reducing valves maintain a constant pressure drop across the metering, 2-way valves.

An accumulator in the pilot circuit of each door-operating system assures constant pressure for accurate actuation speed of the 2-way valves. The accumulator also supplies pilot pressure if the pilot pump fails.

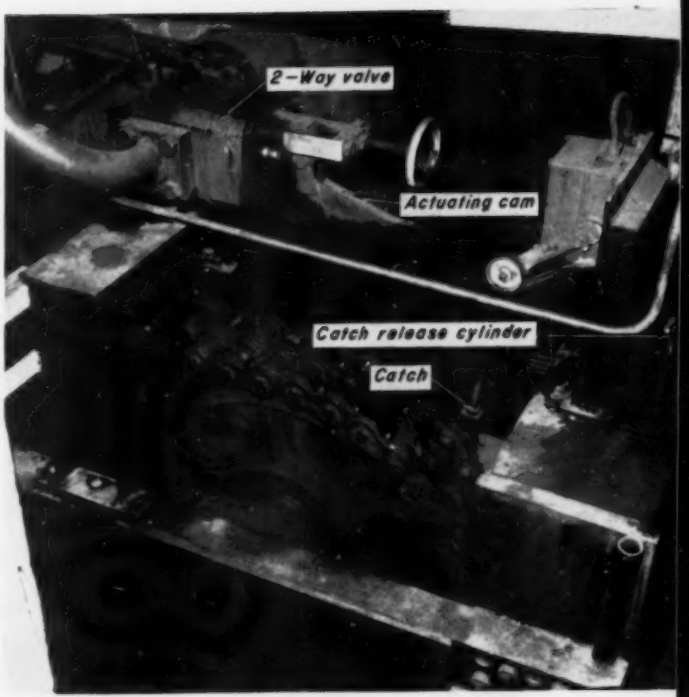
• **Safety Measures**—Reliability and safety of operation are extremely important because any interruption in furnace door operation would shut down the entire mill. To assure safe and continuous operation the following measures are engineered into the system:

1. A synthetic fire resistant fluid is used in the system because of high temperatures.

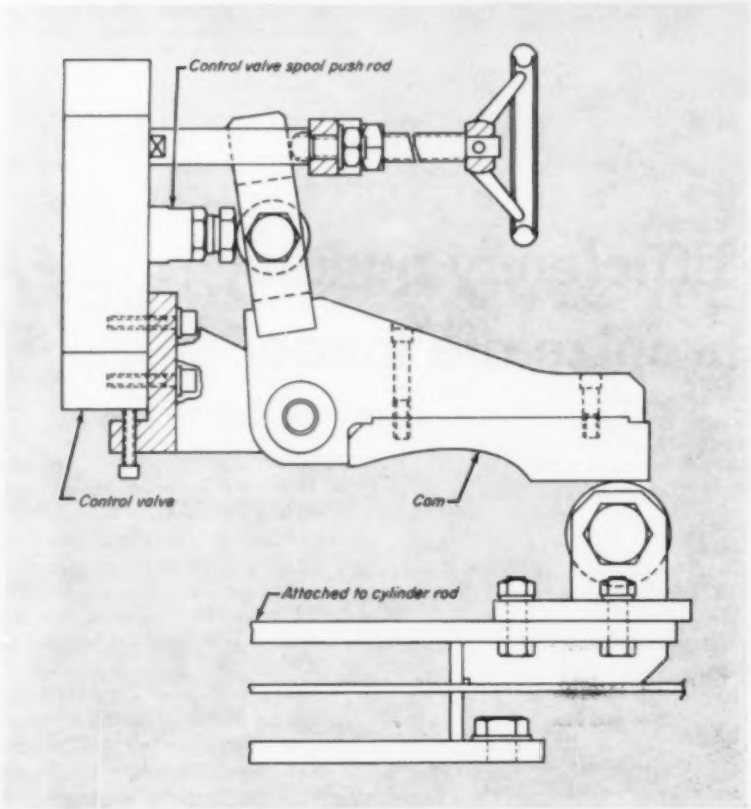


CONTROL VALVE is shifted by a differential hydraulic actuator at one end or by a cam at the other end. The valve is normally held open by pilot pressure applied to the two push actuators. To close the valve, pilot pressure is applied to the four pull actuators which have a larger combined area. Valve speed is controlled by metering fluid to and from the push actuators, or by the cam. The spool gives a linear increase or decrease in flow when it shifts at a constant speed.

2. A normally-closed, solenoid pilot operated shut-off valve in the discharge line from the accumulator closes automatically if pilot pressure needed for actuating the main control valves becomes dangerously low.
3. Manually-operated shut-off valves in each door moving circuit permit closing the doors if hydraulic power fails.
4. A separate pilot exhaust line containing an air bottle prevents backpressure surges which might be caused by the long pipe lines.
5. Relief valves limit pressure to each cylinder.
6. Each cylinder has a built in cushion which restricts flow and permits the cylinder to come to a smooth stop if a tube or pipe bursts.
7. A mechanical catch prevents the weight of the doors from retracting the ram type cylinder when the door is closed. The catch automatically engages the ram when it extends fully. Pilot pressure to the 2-way valves actuates a small cylinder to release the catch. The minimum pressure required to operate the main valve determines the pressure at which the catch disengages. This prevents releasing the catch without sufficient pressure to the 2-way valves.
8. Limit switches monitor the position of cylinders, main valves, and catch to assure proper sequence. ▼▼▼

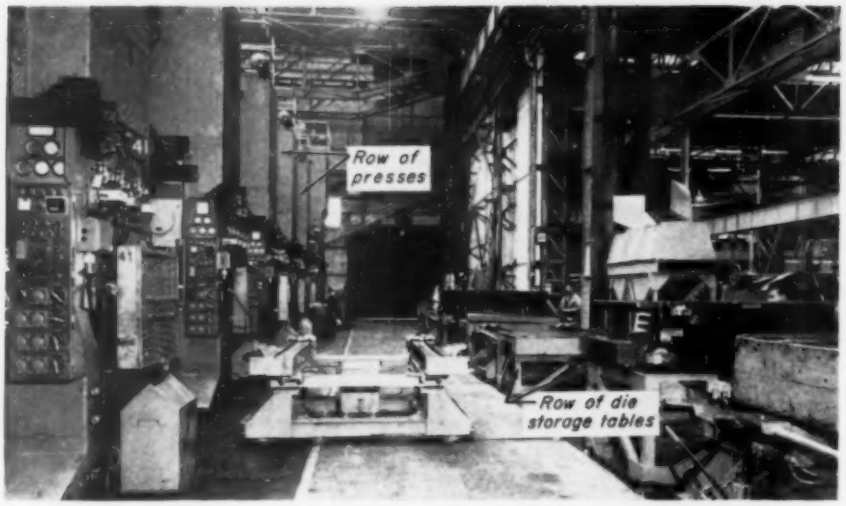


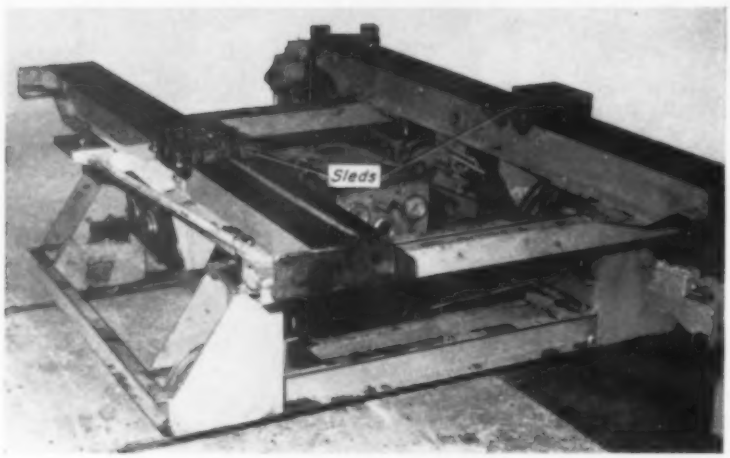
MECHANICAL CATCH prevents cylinder creep because of furnace door weight. When the control valve shifts, the catch is released by pilot pressure applied to a small cylinder. The cam decelerates cylinder at the end of its stroke by throttling flow through the 2-way valve. Length and form of the cam determine the cushioning.



DECELERATION CAM slows down the cylinder at the end of its stroke and gradually accelerates the cylinder when it reverses. A roller, moving with the cylinder rod, contacts the cam near the end of the cylinder's stroke. The cam lifts, moving the control valve push rod to close the valve.

FRANCE





ROW OF 400-TON PRESSES on the left faces row of die-storage tables. Track-mounted rolling tables shuttle dies between presses and tables.

ROLLING TABLE has two conveyor chains driven by radial piston motors. Sleds can be controlled individually for proper die positioning in the press.

High efficiency pumps synchronize die loader

● By **R. AFFOUARD,** *General Manager, Hydrem, Paris, France*

High volumetric efficiency of reciprocating plunger pump keeps delivery constant regardless of load (and pressure) changes.

WHEN a die must be installed in one of the 400-ton presses in a French auto plant, it is mounted on two chain conveyors on a rolling table. The table is pushed in place and aligned with the press. Hydraulic motors then drive the conveyors to transfer the die onto the press.

The two chain conveyors must run together so that the die moves onto the press without cocking. But the operator must also be able to *steer* the die to set it on locat-

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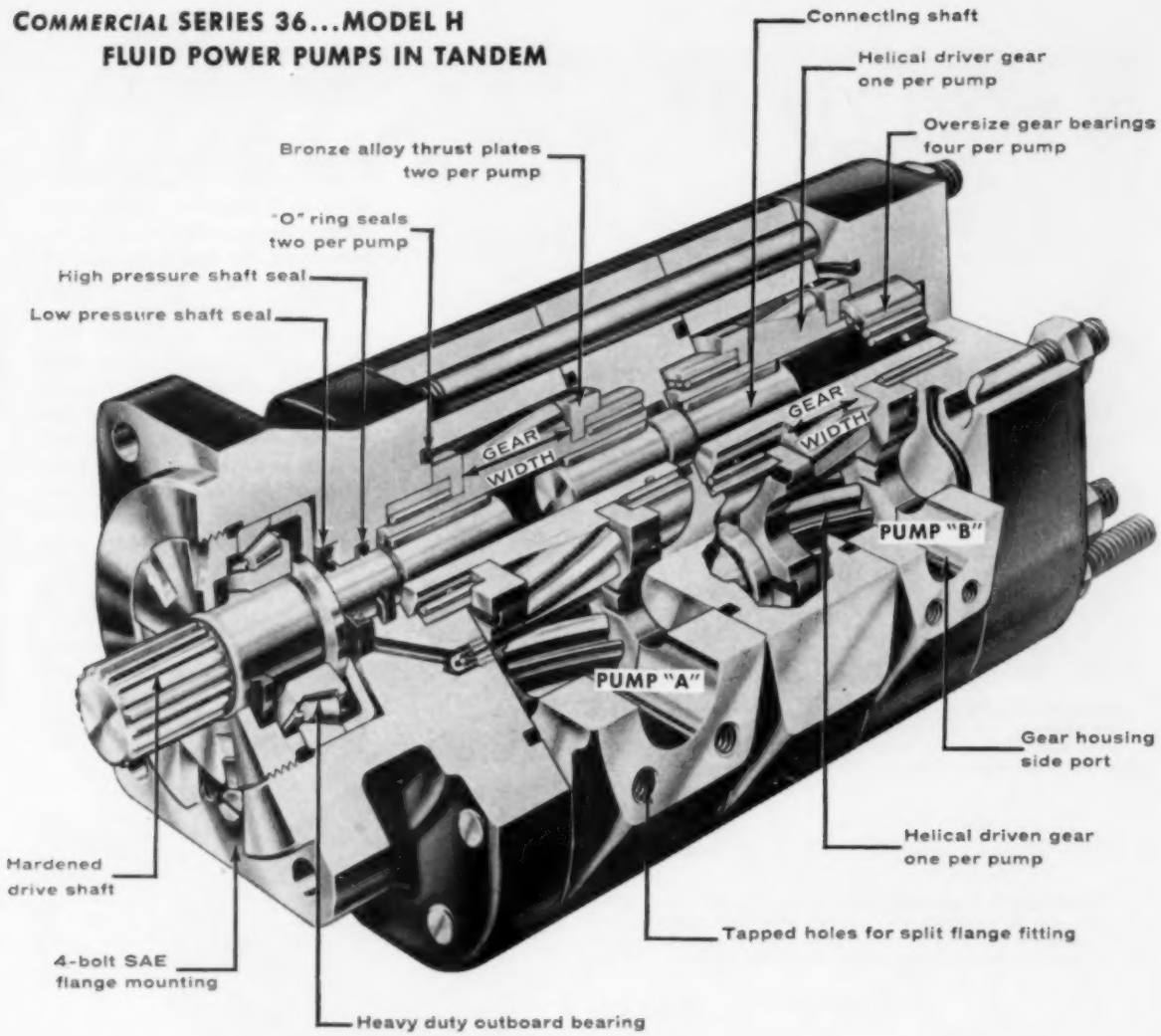
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Oversize gear bearings four per pump
Bronze alloy thrust plates two per pump
"O" ring seals two per pump
High pressure shaft seal
Low pressure shaft seal
GEAR WIDTH
GEAR WIDTH
PUMP "B"
PUMP "A"
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GEAR WIDTH SUMMATION FORMULA
(based on pumps A, B, ··· F)
A pump (GxP) + B pump (GxP) + ··· F pump (GxP) = 12,000
(G = gear width (in.) of single pump; P = operating pressure (psi) of single pump; 12,000 = constant)

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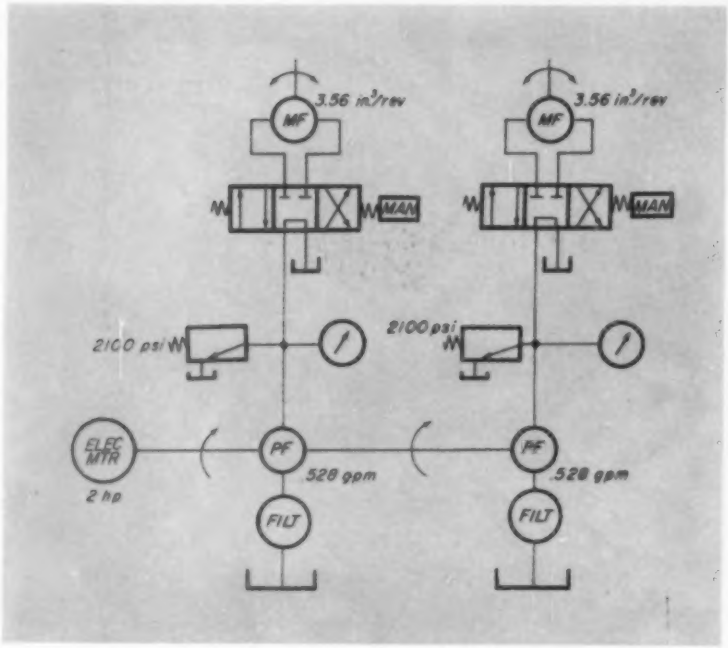


SEPARATE PUMPS operate at 2000-psi system pressure to supply chain conveyor motors. High volumetric efficiencies of pumps and motors keep chain speeds synchronized. Pumps are installed in the reservoir which supports the electric drive motor.

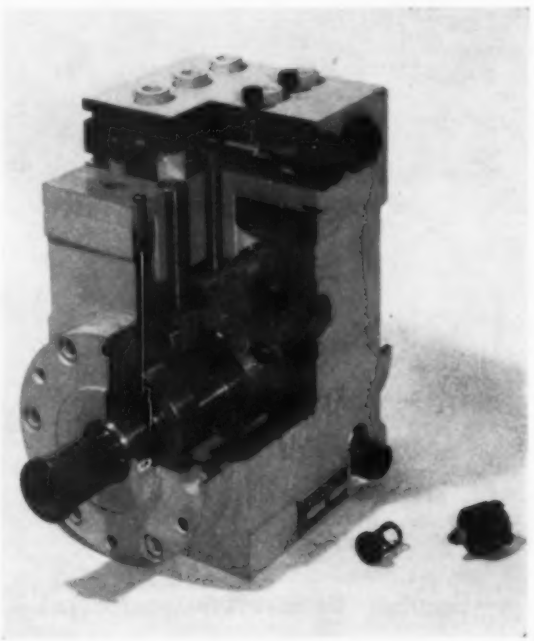
HIGH EFFICIENCY PUMPS SYNCHRONIZE

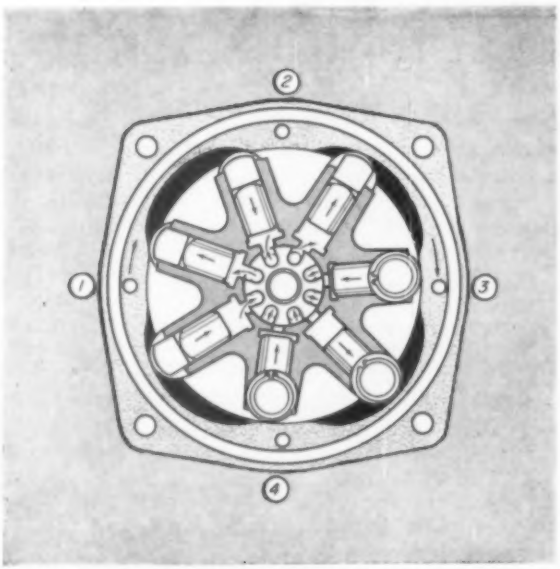
ing pins in the press.

Each piston type motor is supplied by a separate reciprocating plunger pump with identical displacement. The high volumetric efficiency of this pump design (about 99%) makes delivery constant regardless of pressure. With radial piston motors having little slip, chain speed remains constant for any die configuration and consequent motor loading pressure).

A manually operated, 4-way valve controls each hydraulic motor. If both levers are actuated together, they will synchronize the linear speed of both conveyor chains. Either motor may be slowed down, or even reversed, if necessary, to permit the operator to align a die on its locating pins in the press. This die transfer design has resulted in very little downtime for die changes. ▼▼▼

FIXED DISPLACEMENT, reciprocating plunger pump delivers 0.5 gpm at 1500 rpm. The 3-piston, crankshaft type unit has a volumetric efficiency of about 99%. Integral cylinder head has a built-in automatic valve system to control oil flow in the unit.





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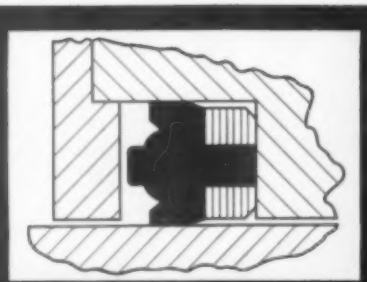
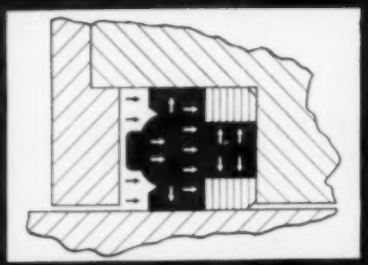


The SCN ring

(Patent No. BP 805253)



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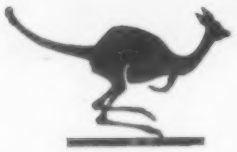


Metering valve

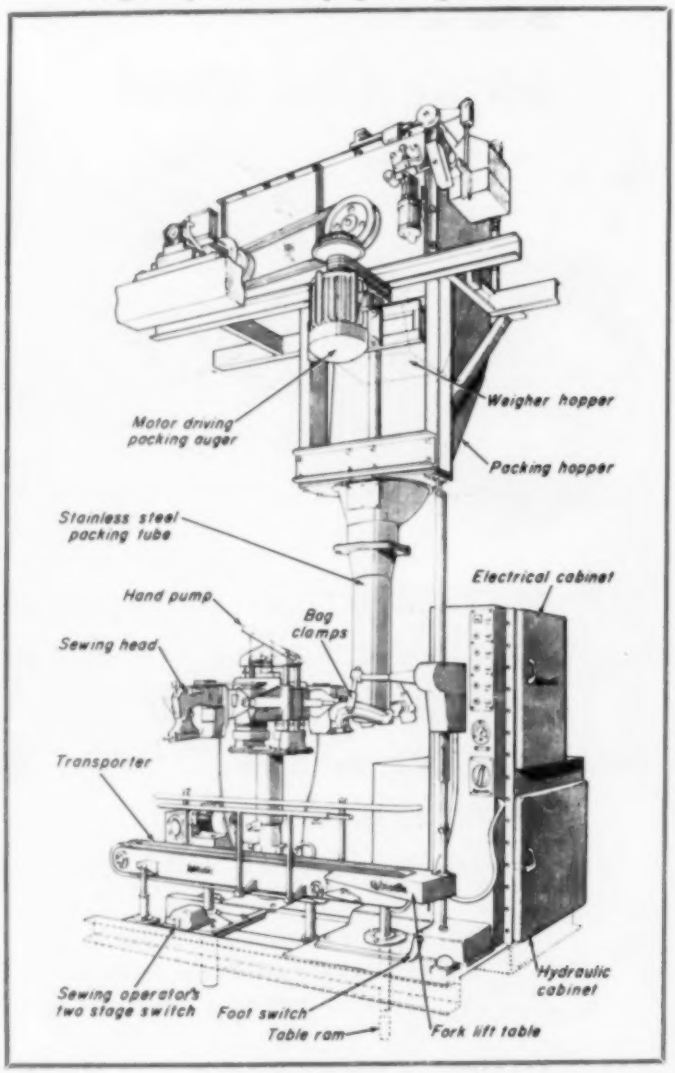
• By **A. T. STANNERS,** *Production Manager, Thomas Robinson & Sons Pty. Ltd., Sydney*

This high speed packer fills six 150-lb bags per minute. (With a denser pack preferred by Australian millers, the packing rate is reduced to about four bags per minute.) The former machine required skilled operators and packed only one bag per minute.

DENSITY of flour packed in a bag depends on how fast the bag moves down as flour is forced in. This high-speed hydraulic packer controls flour density by an easily adjusted flow control valve.

The operator places an empty bag under the opening of the stainless steel packing tube and presses a foot switch to start the automatic packing operation. This closes the venting valve (see circuit diagram) so that the pump delivers to the system. It also energizes valves 1 and 3. The lift table starts to move up, and the bag clamp closes, clamping the bag around the tube.

HYDRAULIC CONTROLS and electrical switchgear are enclosed in cabinets. In addition to the hydraulic controls, the lower cabinet houses a 32-gal reservoir and a 1000-psi, single stage, vane pump. The electrical controls are enclosed in the top, dustproof cabinet. This installation is in Manila.



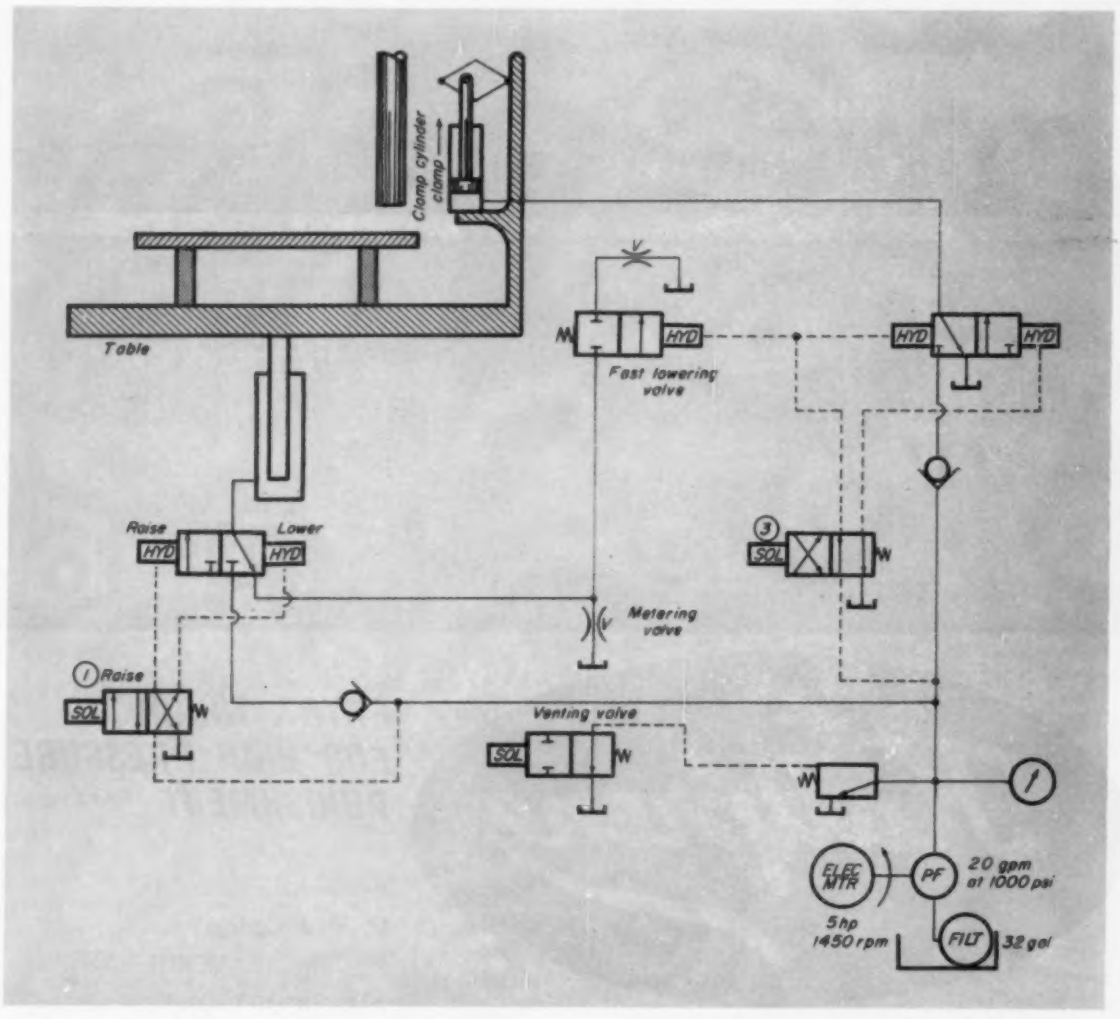
controls density of flour

and **JOHN L. SUTTERD,** *Manager, Sydney Office,*
Vickers-Detroit Hydraulics Pty. Ltd., Victoria, Australia

Since the bag clamp is part of the table assembly, it rises to the top of the tube with the bag fully extended along the tube.

On reaching this extended position, the table trips a limit switch which de-energizes valve 1 and the venting valve, unloading the pump. The limit switch also releases a preweighed batch of flour into the packing hopper and starts the packing auger within the tube. The table cylinder is then open to tank through a metering valve. The table assembly lowers at a rate determined by the setting of the metering valve. Since the auger forces flour into the bag at a constant rate, the setting of the metering valve determines the density of the pack.

When the auger has forced the pre-set quantity of flour into the bag, valve 3 is de-energized. This opens the clamp and releases the bag. Also, oil from the lift table cylinder dumps to tank, allowing the table assembly to seat quickly. When the bag is clear of the tube, the operator starts the V-belt transporter, conveying the bag to the sewing machine, then to the conveyor. ▼▼▼



VENTED RELIEF VALVE AND VENTING VALVE combination saves power and pump wear because the pump is loaded only when required during the packing cycle. Electrical interlocks prevent the packer from operating if the lift table is not correctly seated at the bottom of its stroke or in case of other malfunctions.

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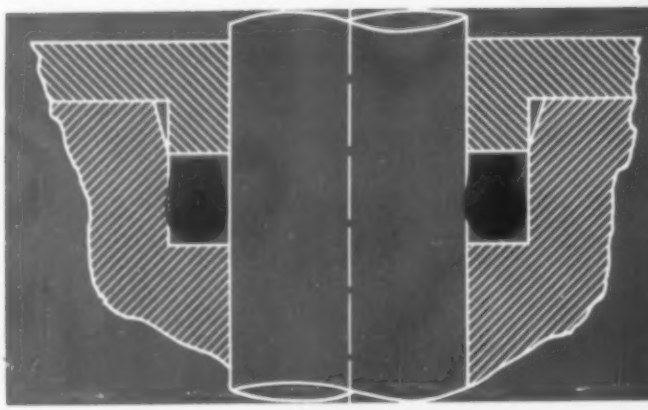

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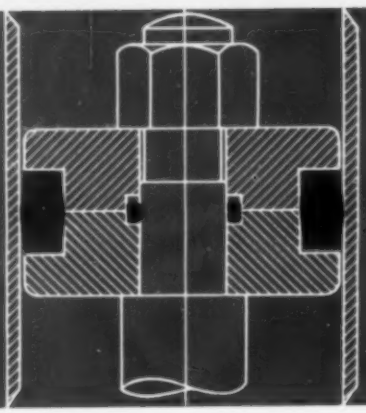

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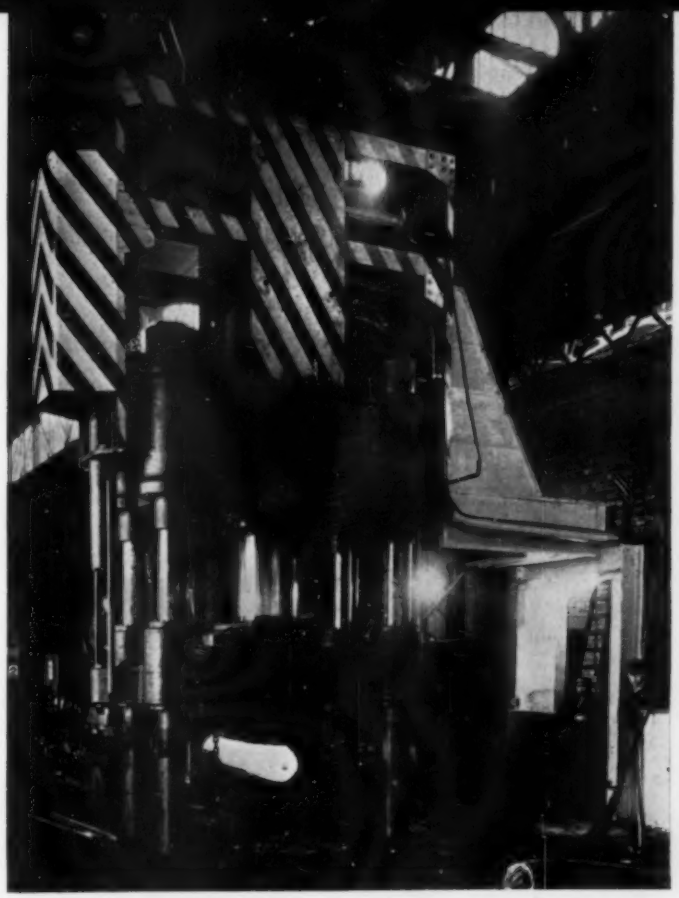
ENGLAND

The growth of hydraulic forging

• By F. H. TOWLER and B. C. WILKINS
Towler Brothers (Patents) Ltd., Leeds, England



PRESS OPERATING at 5700 psi forges alloy steel at Usine Gilson in Belgium.

FORGING high-speed steel bars has to be done quickly and with as few strokes as possible because they have a limited forging temperature and crack easily.

Though presses have been used for forging carbon and low alloy steels for nearly a century, rapid acting presses of 500 tons capacity were still not available just 10 years ago when Towler Brothers Ltd. launched its forge press development program. One of the major objectives was faster press speeds. Two major decisions were made:

- To switch from water to oil hydraulics
- To develop improved oil hydraulic components

Water has serious disadvantages in forging presses. Although it is cheap, it requires large and expensive pumps and valves. These components must be big enough to resist the damages of cavitation which require frequent overhauls even at the slow operating speeds of water systems. Corroded products of cavitation score piston rods and packings and cause leaks.

High-pressure, high-speed oil pumps that delivered 25 gpm were developed in the meantime. By combining a number of these, it was possible to obtain pumping capacities of 250 gpm.

• **Combining Pumps for Higher Speeds**—A press was designed to operate at up to 100 strokes per minute with the following specifications:

• Force	1000 tons
• Penetration speed	2 in./sec.
• Approach speed	12.5 in./sec.
• Return speed	19.5 in./sec.
• Pump capacity	220 gpm
• Operating pressure	4000 psi

The fast speed required a shock-free, decompression time of the main cylinder of 0.1 second, compared with 1.0 second for the water presses. Operating on the direct system, each stroke required only one valve operation involving a pressure differential.

In testing the press, a mirror galvanometer recorded pressure in the main and return cylinders, control lever and crosshead movement, and motor current and voltage. Successive blows were made with the control lever held down. After each blow, the press returned automatically at a preset pressure. Half the stroke was wasted in compressing the supporting blocks and the oil in the hydraulic system. A remotely adjustable stroke limiter was needed.

• **Pilot Control Permits Manifolding**—The large manual valves used to control forging and other large presses were hard to operate. In one forge in The Netherlands, for instance, the press man worked 30 minutes, then rested 30 minutes. Pilot controls ap-

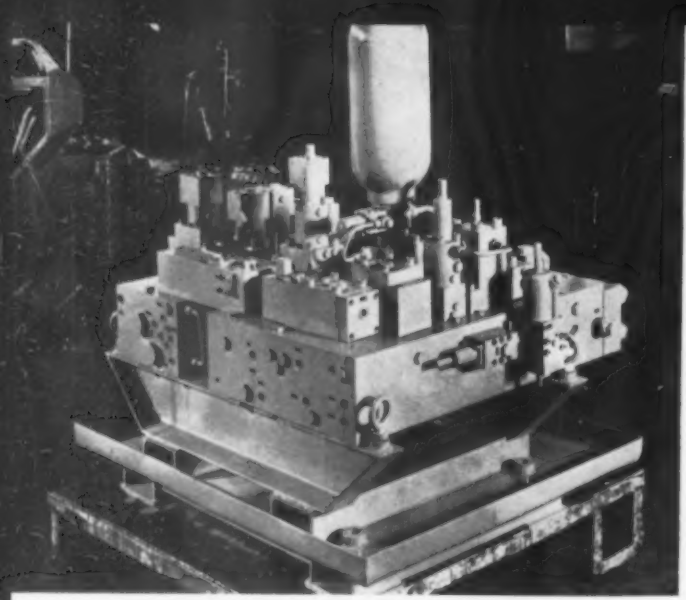


FIG. 1. MANIFOLD VALVE assembly has control valves mounted on steel block drilled with passages connecting pump to press.

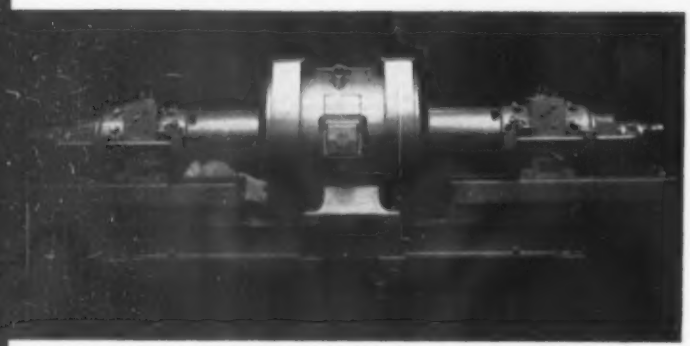


FIG. 2. DOUBLE PUMP and motor unit is compact and can deliver 1000 hp nominal.

peared to be a solution which could reduce manual effort. Piping could also be reduced by the use of manifolds.

When the first manifolded design was installed at Usine Gilson at La Croyère, Belgium, the result was faster operation. All high pressure valves were mounted on a steel manifold block shown in Figure 1. The drilled block made connections to port pressure oil from the pump to the press. A control panel housed the pilot valves which operated 1/10th the pressure of the main system. Specifications for the press were:

• Force	1200 tons
• Penetration speed	2.5 in./sec.
• Approach speed	16 in./sec.
• Return speed	16 in./sec.
• Pump capacity	250 gpm
• Operating pressure	5700 psi

Similar controls were also installed on presses in Russia and France. In each case they operated faster.

• **Stroke Control Development**—It is usually fairly simple to stop the stroke of a forging press at any predetermined position: all that is needed is a cam-operated pilot valve that can be adjusted over the stroke. But presses that require frequent adjustments of forging thickness present a more difficult problem. Here is why:

- The operator must be able to move the valve from one position to another accurately, quickly, and from a remote control position.

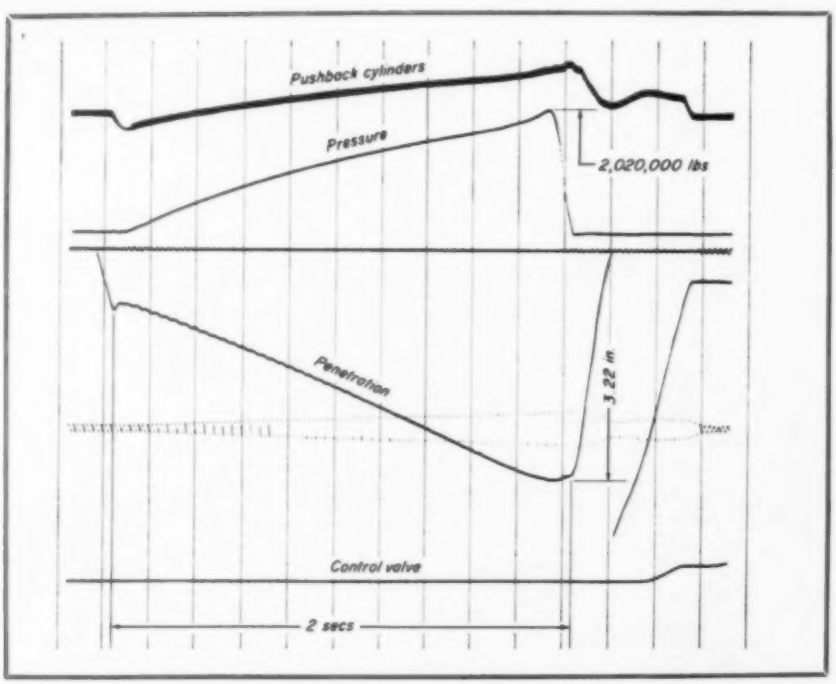
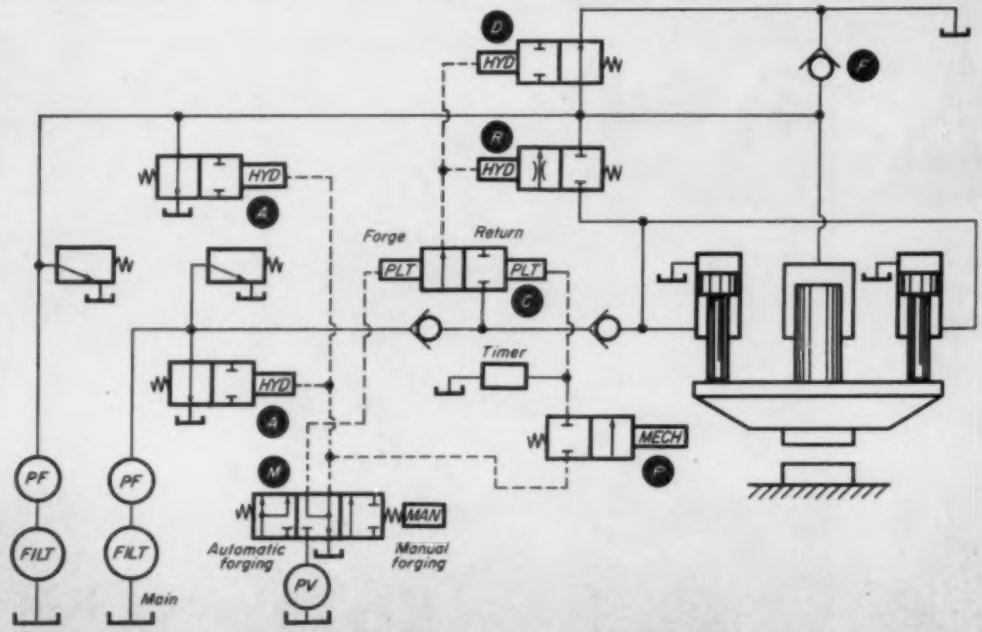


FIG. 3. PERFORMANCE TRACE of press in operation at Usine Gilson, Belgium.

HOW THE AUTOMATIC PRESS WORKS



When main valve *M* is shifted to its automatic forging position, pilot pressure shifts valve *C*. Valve *C* supplies pilot pressure to close valves *A* and *D* and open valve *R* which controls flow to the main cylinder. Pre-filling valve *F* is self-actuating and opens to admit oil from the reservoir into the main cylinder. When the top die contacts the work, flow into the main cylinder reduces, and valve *F* closes automatically. After the forged piece has been squeezed to its required thickness, the press actuates pilot valve *P* which shifts valve *C* to return detented position.

With pilot pressure from valve *C* blocked, valves *D* and *R* are spring shifted, and fluid from the main pump goes directly to the two single-acting cylinders which begin to raise the press. Fluid from the top of the main cylinder exhausts through decompression valve D. A hydraulic timer ends this return stroke. Note that during this entire operation valve *M* was in its *automatic forge* position.

When *M* is shifted to *neutral*, it exhausts unloading valves *A*. In the *manual forge* position, it again actuates valve *C*. This provides the operator with full manual control for vicing, knifing, setting-up, or marking-off. For repeated forge strokes, such as cogging or finishing square or round stock, control is simplified to a point where the manipulator driver can also control forging.

- For any forging thickness, the stopping point has to be corrected for the height of the die in use at that particular time.
- To maintain good accuracy, the delay time between the moment the valve is actuated to the instant the press stops must be very short.

Experience with the high-speed steel forging press in Sweden showed that pilot operation could actuate valves and decompress cylinders quickly with an accurate control of forging thickness. Furthermore, with constant return speeds time limiting devices would control daylight opening. Sufficient experience and knowledge had now been gathered to design a fully automatic forging press.

A press with thickness controller was installed in 1958 at Walter Somers in England. Its specifications were:

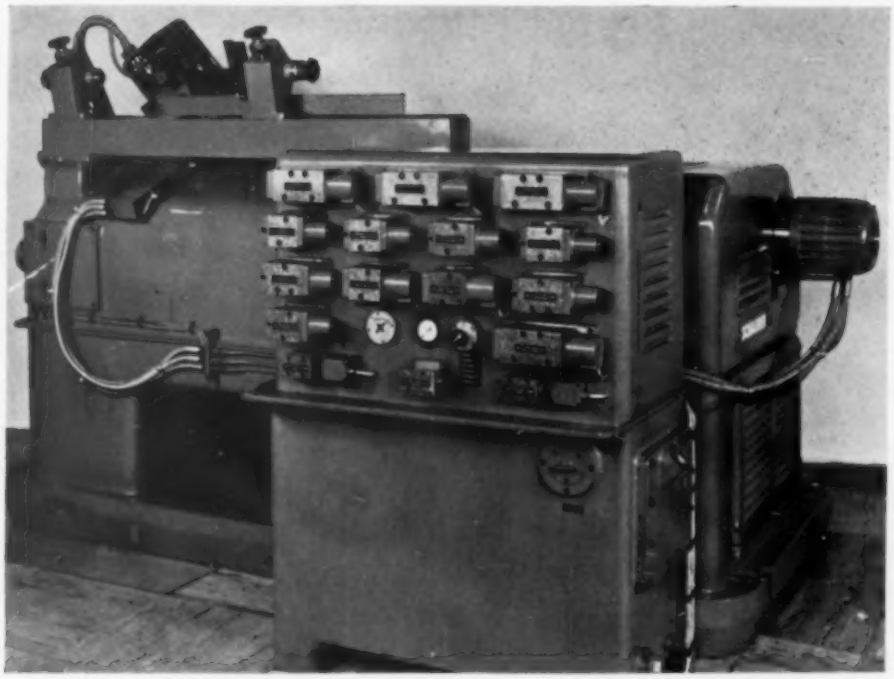
• Force	500 tons
• Penetration speed	3 in./sec.
• Approach speed	18 in./sec.
• Return speed	20 in./sec.
• Pump capacity	176 gpm
• Operating pressure	4500 psi

The press was installed together with a rotary table manipulator and a rotary hearth furnace.

Many press manufacturers were now planning to re-equip their plants. Where hammers needed replacing, the solution was fairly simple: the existing installation could meet all requirements. In plants where large presses were to be installed, (presses up to 15,000 tons) the number and size of pumps that would be required to drive the system was prohibitive. The practice was to install the pumps and controls in a pit, and let the inverted press occupy the entire floor. Conventional presses were obviously unsatisfactory for very large installations, and high pressure pumps of greater capacity were needed.

Design of a 500-hp pump to deliver 150 gpm at 5000 psi and 1500 rpm was started. For still higher pressures (6000 psi) pump capacity would have to be slightly reduced. Figure 2 shows a double pump and motor unit rated at 1000 hp nominal. This unit is relatively small, and would take up little space even if it were necessary to connect five double-ended motors in tandem to drive a 15,000-ton press. ▼▼▼

GERMANY



PANEL-MOUNTED VALVES are part of a separate hydraulic control cabinet on a hydraulic copying lathe.

German hydraulic design goes to

• By **GERHARD W. SCHNEIDER,** *Mechanical Engineer, Singen/Htwl., Western Germany*

PANEL MOUNTING of hydraulic components is replacing hydraulic power and control blocks in German machine tool design. The hydraulic block is an integrated assembly of pump, motor, and control components. It is installed in the machine as a single unit. This building block principle has been used particularly in Germany for the last 25 years in various machine tools. Designers considered it advantageous to combine all hydraulic elements in one self-contained unit. Other advantages are compactness, ease of machine assembly, and very little external piping.

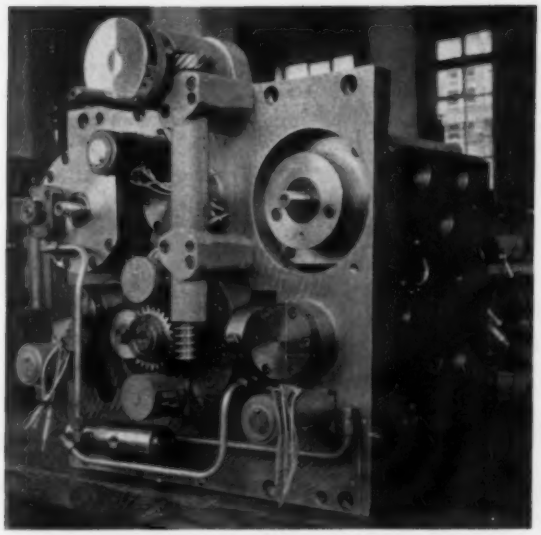
Disadvantages of custom designed blocks limit their use in high production, automatic transfer machines. They are expensive to design and develop and can only be applied to a limited number of machines. They require long, expensive repair time in case one component fails. So, in Germany today, hydraulic blocks have only standard, proved components.

• **Growth of Panel Mounting**—As high speed, automatic machines developed, they needed a more flexible fluid power design. Panel mounting originated in electrical system design, where the same components are used in many different system. Although panel mounting has long been common in electrical design, it has only recently become practical in hydraulics with the introduction of the O-ring during World War II. The O-ring is a key element for further progress in industrial hydraulics.

Panel mounting's outstanding features are adeptability, flexibility, and simplified maintenance. Downtime is very short.

In the U. S. the panel mounting principle was adopted very rapidly. Within the last five years, German machine tool builders have also recognized its merits. Panel mounting is popular with German machine tool builders because it is well accepted by their customers. Also, several U. S. hydraulic component producers have established manufacturing plants in Western Europe and have advocated this new way to

HORIZONTAL MILLING MACHINE has a hydraulic power and control block installed behind the control panel.



HYDRAULIC POWER AND CONTROL BLOCK for a modern, heavy duty milling machine has pump and control components integrated in a single building block. Hydraulic block design was developed after 1928 when fluid power was first successfully applied to a milling machine drive. Its success stimulated use of hydraulics on almost all machine tools.

panel mounting

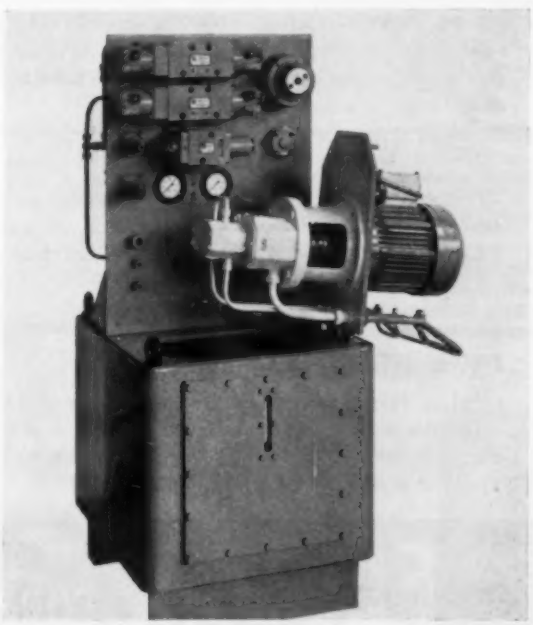
use their products.

• **Manifolds Limited**—Drilled or sandwich manifolds are not common in German machines even though manifold brazing, drilling, and welding techniques are known. This is because manifold panels are costly, and they have to be custom designed for an individual machine. However, there is considerable interest in building up hydraulic panels from *standardized* baseplates.

There are many indications that a separate hydraulic control cabinet will become a new standard item. Some firms already specialize in the manufacture of standard hydraulic cabinets. The separate cabinet permits the machine tool designer to remove heat, generated in the hydraulic power pack, from the body of the machine. This increases machining accuracy and precision.

Generally standardization of hydraulic components is a major activity in German hydraulics industry.

▼▼▼



STANDARD HYDRAULIC POWER PACK AND CONTROL PANEL has double pump flange-mounted on electric motor. Hinged pump-motor assembly and panel-mounted valves simplify maintenance.

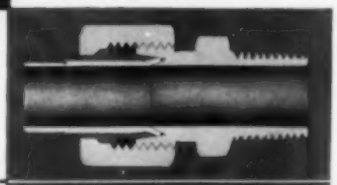
FLODAR HAS THE FITTING!

. . . your most complete source for all types of—Hydraulic, Pneumatic Instrumentation, Lubrication and Process Fittings.

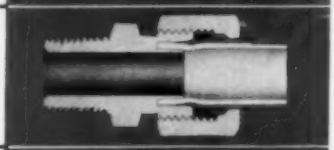
Flodar fittings are available in sizes from 1/8" to 2" in steel, brass, stainless and aluminum.

For use with steel, copper, stainless, aluminum and plastic tubing.

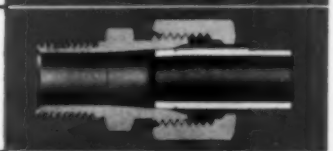
TUBE FITTINGS — J.I.C. Standard



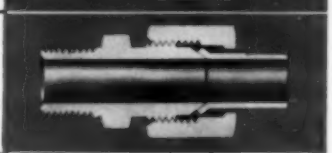
FLODAR ***SELF-FLARE*** FITTINGS — No tube flaring or special tube preparation is required. The fitting is simple to assemble and assures a leakproof seal for pressures exceeding 20,000 psi. All common shapes available. A reliable and economical fitting for all installations.



FLODAR ***SELF-LOCK*** FITTINGS — Designed for use with nylon and other types of plastic tubing. Exclusive internal tube support and collet gripping action prevent blow-outs and pull-outs. Available in all common shapes for both thin and heavy wall plastic tube.

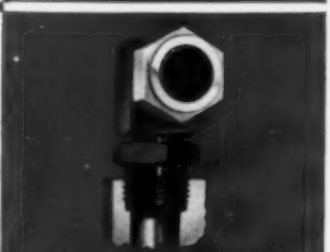


FLODAR NO-FLARE FITTINGS — Special construction assures a safe, sure seal without threading, flaring or soldering. Three-point tube support with alloy steel sleeves absorbs vibration and assures maximum sealing action.

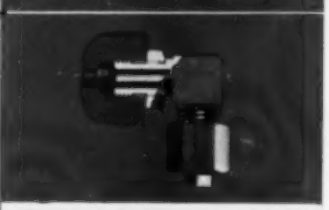


FLODAR FLARE FITTING — Popular three piece 37°-flare fitting, using heat-treated alloy sleeve. Designed to meet high pressures and excessive fluid shocks. AN dimensions.

PORT HOLE FITTINGS — J.I.C. Standard

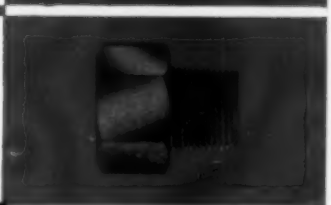


FLODAR ***SELF-SEAT*** FITTINGS — The exclusive "no-swing" design of this port fitting permits installation in extremely confined spaces and metal to metal seal insures leakproof connection. Fitting consists of a stem and body with floating nut. Tightening the nut forces the stem into it's seat forming its own leaktight seal. No special seat preparation is required. "O" rings are eliminated. Available in all standard shapes and sizes with ***"SELF-FLARE," "SELF-LOCK,"*** "Flare" and "No-Flare" tube ends.



"O" RING FITTINGS — This "O" ring fitting fits all S.A.E. portholes and is available with AN large hex. Available in all common shapes with ***SELF-FLARE, SELF-LOCK,*** Flare and No-Flare tube ends.

PIPE FITTINGS — J.I.C. Standard



FLODAR PIPE FITTINGS — a complete line of FLODAR high pressure steel pipe fittings are available in all popular shapes and sizes. Machined from solid bar stock, with dry-seal precision threads. A variety of adapters and reducers are available to simplify your piping problems.

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Write for complete catalog information on the fittings described.

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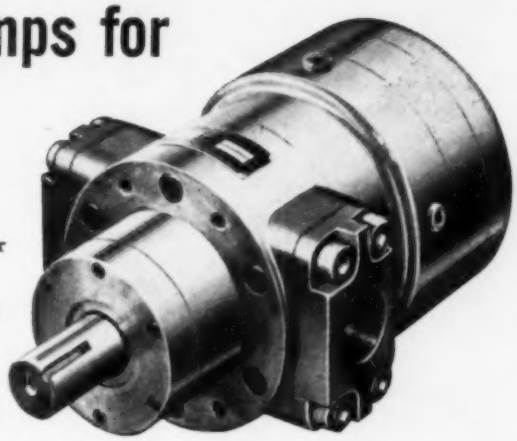
Stocks in All Principal Cities — Largest Selection of Shapes and Sizes — Prompt Delivery.

Proper selection of constant volume axial piston hydraulic pumps for systems up to 5000 psi



By: Ellis H. Born

Director of Sales-Engineering
Denison Engineering Division
American Brake Shoe Co.
Columbus, Ohio

Whether to use a high pressure system or a low pressure system is perhaps the most basic decision the designer faces in developing the proper hydraulic system. This decision involves such factors as efficiency, space requirements and, most important, cost.

SPACE CONSIDERATIONS

Furnishing fluid horsepower is the function of a hydraulic system. Horsepower yield is determined by multiplying system pressure (psi) times flow rate (gpm) times a constant of 0.000583. Application of this formula reveals that a 5000 psi system develops five times the horsepower of a 1000 psi system at the same rate of flow. Accordingly, the 5000 psi system requires only 20% of the flow rate of a 1000 psi system to produce the same fluid horsepower.

Reduced rate of flow permits designs which incorporate smaller valves, piping, hydraulic cylinders and reservoirs. Since reservoirs are often the largest single fluid component in a system, appreciable space savings can be realized with high pressure systems. If recommended hydraulic practice is followed, reservoir capacity is three times greater than the gpm displacement of the pump. Hence, for the same amount of fluid horsepower, reservoir capacity can be reduced as much as 80% in a high pressure system. The high pressure system not only allows savings in space through use of smaller components and capacities, but reduces the weight and mass of the hydraulic power package as well.

COST FACTORS

Use of smaller components in high pressure systems not only saves space, but affords worthwhile cost reductions.

Compact system elements cost less and because they are smaller, as well as lighter, assembly is easier and faster. Raw material requirements are also reduced. These advantages permit the over-all hydraulic system design to incorporate less weight and mass. The latter is especially important where portability is concerned.

SYSTEM EFFICIENCY

In any hydraulic system, a part of the generated fluid horsepower is used to force fluids through the system. Resultant line and pressure decreases are far less significant in high pressure systems. For example, a pressure drop of 50 psi represents a loss of 5% in a 1000 psi system, but only a 1% loss in a 5000 psi system. It follows that high pressure systems have an inherent efficiency advantage over low pressure systems.

The ability to provide sustained efficient power for a high pressure system is best fulfilled by a precision-built axial piston pump because of its low slippage rate and operating characteristics.

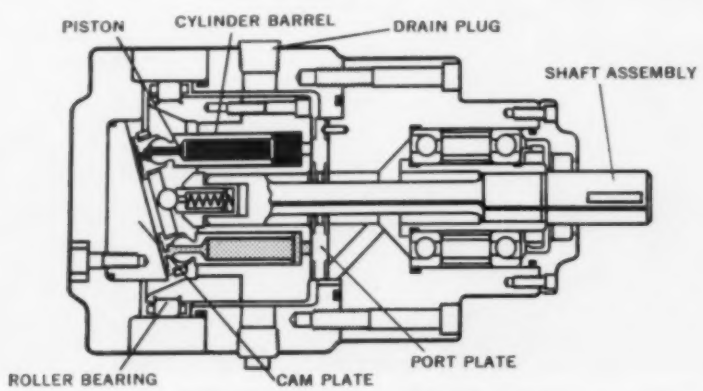
All internal forces created by hydraulic pressure against the moving parts are counteracted by the use of hydraulic balancing.

Using the principle of hydrostatic balancing eliminates the need for expensive and often cumbersome thrust bearings in the pump. This design minimizes pump size and allows a more compact pump or fluid motor package.

Other advantages are gained through hydrostatically balancing pistons and the cylinder barrel. For example, excessive loading of piston shoes against the cam plate is avoided. In addition, excessive loading of the cylinder barrel against the port plate is prevented, virtually eliminating wear caused by sliding action.

Life expectancy of internal axial piston pump parts is almost infinite since constant lubrication is supplied by system fluid.

Data and specifications on 5000 psi pumps, motors and controls are available from your Denison representative—located in principal cities—to assist you in developing hydraulic systems for maximum efficiency and economy.



DETAILS OF CONSTRUCTION

NEW CATALOG FOR DESIGNERS AND ENGINEERS

Write for your copy of Bulletin 220—"Hydraulic Power to 5000 psi" and Bulletin 203—"Axial Piston Pumps". Includes complete specifications, operating data and applications for Denison's full line of hydraulic pumps, motors and controls.

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American Brake Shoe Company
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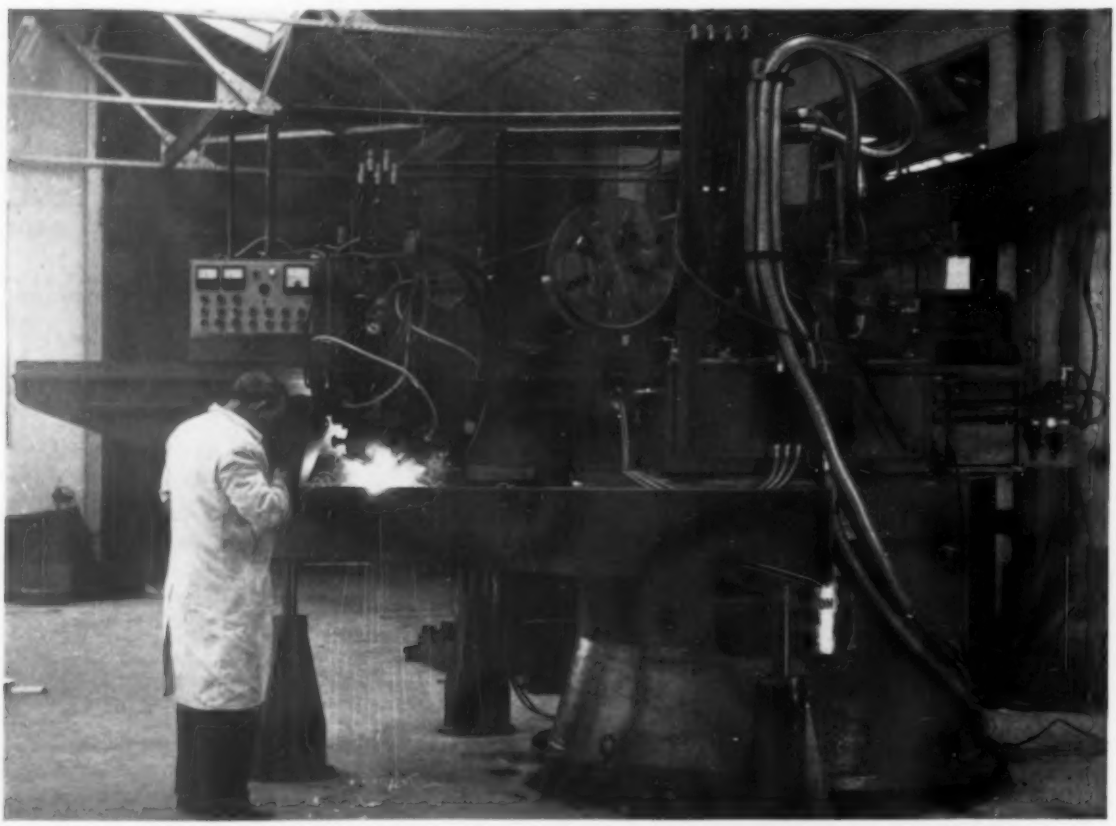
ENGLAND

Tracer and programmed servos combine on welder

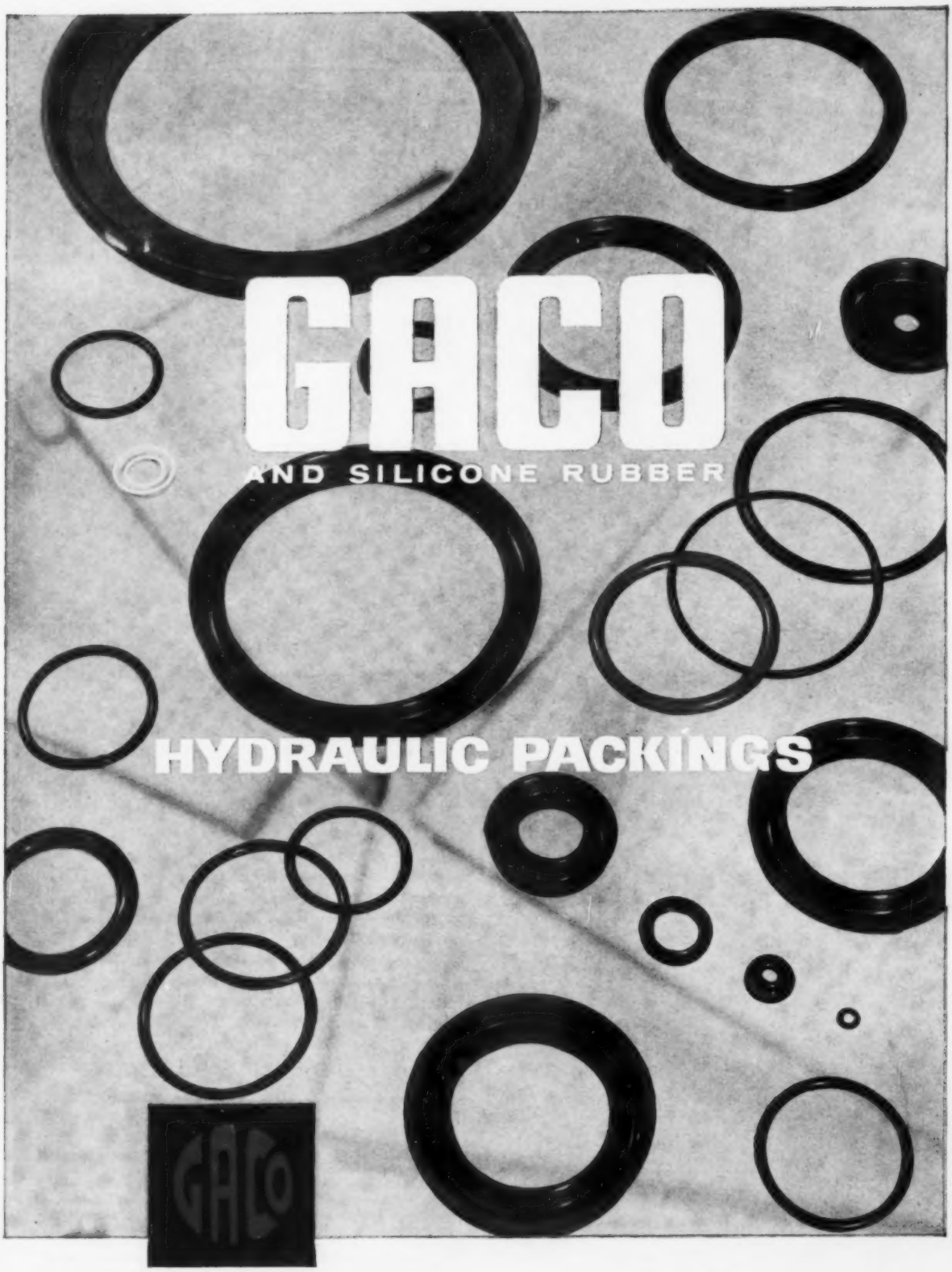
• By **H. IRONS**, *Production Manager, Caterpillar Tractor Co. Ltd.,*
and F. B. LEVETUS, *Technical Director, Keelavite Hydraulics Ltd.*

This machine guides a welder along any irregular path by controlling its movement in two planes. One fluid motor moves the welder in a straight line on a traverse arm. A second motor rotates the machine so it can follow any contour.

MAXIMUM strength is of utmost importance when welding bulldozer C-frames. These irregular shaped members require multiple welds at four joints, each running the entire length of the frame. It is also important that the welder be flexible enough to accommodate any size frame for any size tractor. Caterpillar Tractor Co. Ltd., Newcastle, England, in consultation with Keelavite Hydraulics Ltd., Coventry, England, solved this design problem with electrical, hydraulic,



WELDING HEAD moves on a traverse arm which rotates on a turret. Traverse arm traces welding head's linear path.



GEORGE ANGUS & Co LTD OIL SEAL DIVISION, COAST ROAD, WALLSEND-ON-TYNE
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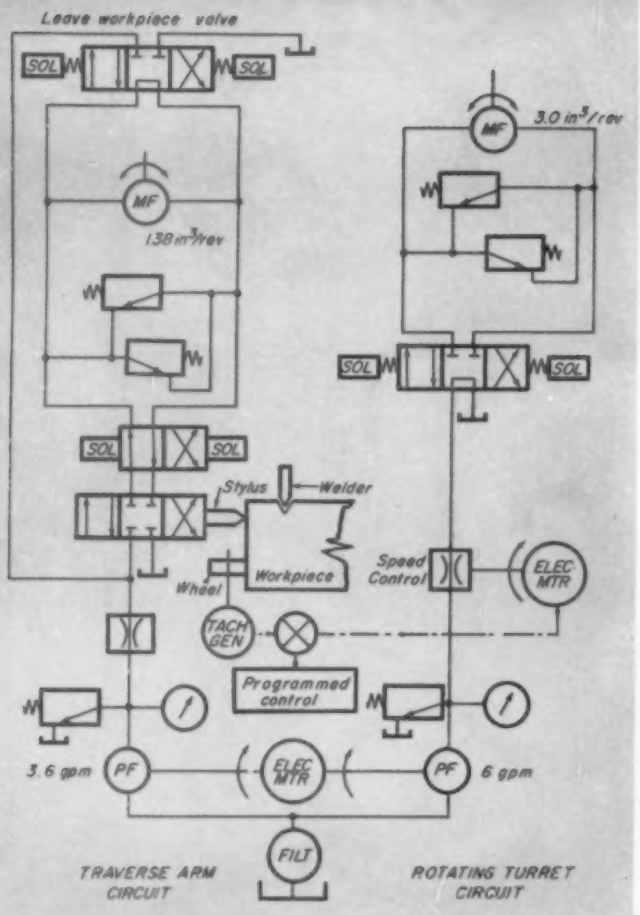
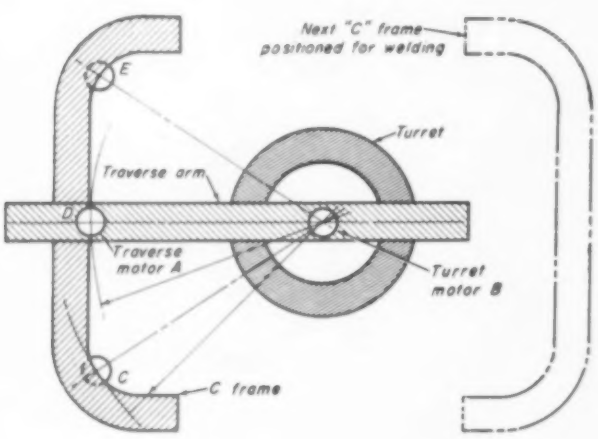


TACHOMETER-GENERATOR wheel rides in contact with workpiece as copying valve follows contour to be welded. The wheel sends signals which are compared to programed signals, mixed, and forwarded to an electric motor. This motor in turn regulates turret speed control valve and adjusts turret accordingly.



TRACER AND PROGRAMMED SERVOS

and servo controls which enabled this automatic welder to lay down a perfect weld at a constant speed.

• **Tracer Linear Motion**—The machine has two main parts: a *traverse arm* mounted on a *rotating turret*. The traverse arm, which supports the welding head and a copying valve, is driven longitudinally by a fluid motor. A stylus on the copying head accurately controls position on the traverse arm by controlling the traverse arm motor.

A 5-port copying valve controls the welder's transverse motion. The valve spool is shifted by a stylus which continually contacts the workpiece. Changes in workpiece contour actuate the stylus and valve spool advancing or reversing the traverse hydraulic motor, and keeping the welding head in contact with the work. A double relief valve across the motor protects it from pressure surges.

Welding head traverse motion is powered by a 3.6-gpm gear-pump in this 500-psi system. The traverse motor has a displacement of 1.38 cu. in./rev., and a torque output of 21 in.-lb./100 psi. A flow control valve adjusts traverse motor speed. One turn of its dial controls 0 to 3 gpm oil flow. Excess oil returns to tank through the relief valve.

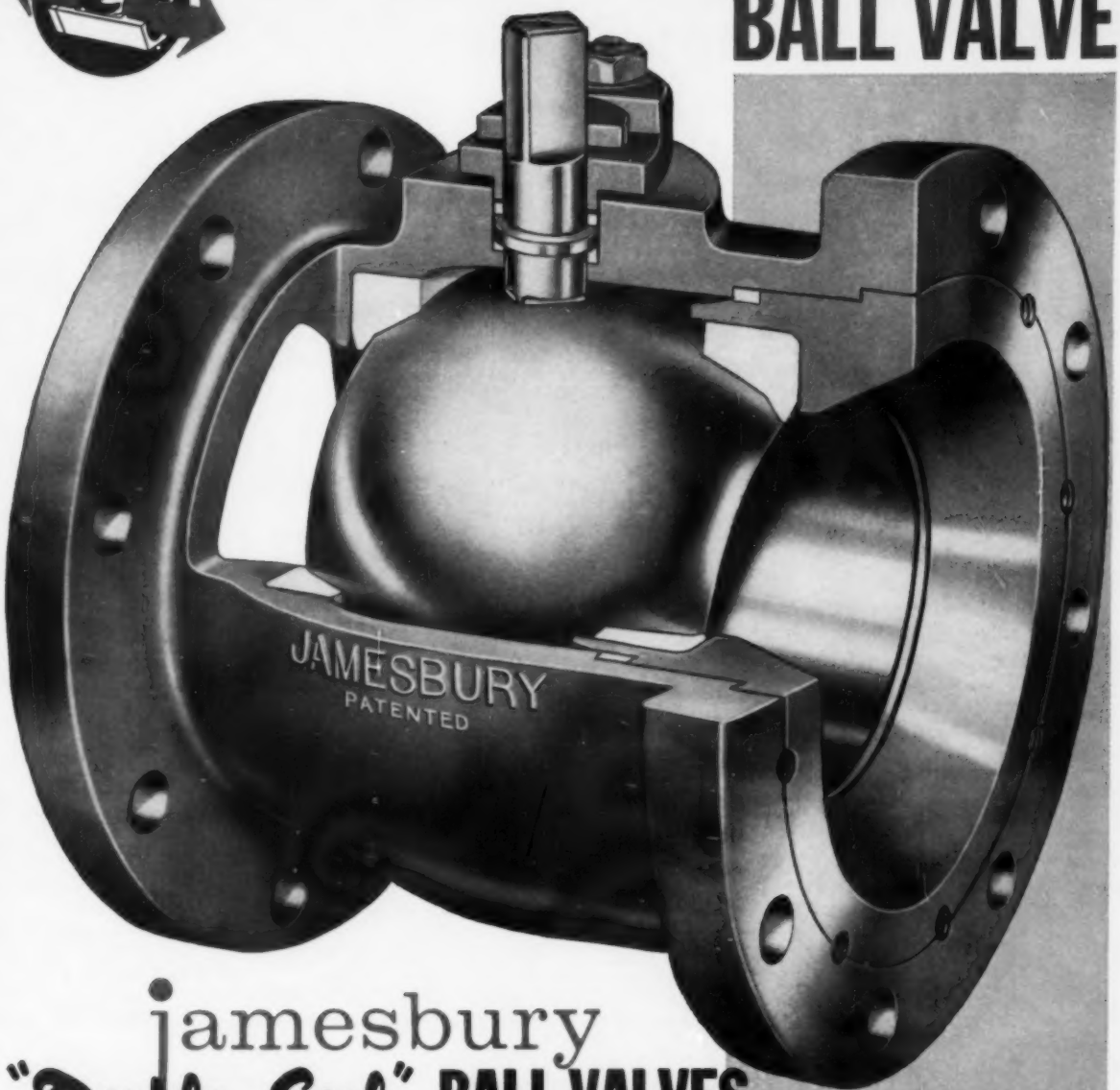
• **Programmed Rotary Motion**—Speed of the rotating turret is programmed electronically. A small wheel runs in constant contact with the workpiece. This wheel is coupled to a tachometer-generator which develops and sends out signals proportional to actual welding speed. The signals are compared electronically to the programmed speed, and any error is amplified to drive a servomotor. The servo positions a flow control valve which regulates the speed of the rotary drive motor according to the contour being welded.

When both valve solenoids are de-energized, pump output returns to reservoir, and the motor is locked. A double relief valve protects the motor from excess pressure. Rotary speed is controlled by a 3-position, 4-way double-solenoid valve and a 6-gpm gear pump. The turret motor displaces 3 cu. inc./rev. and has a constant torque output of 46 in.lb./100 psi. The turret rotates 360 degrees. While one frame is being welded, another one can be set up on the opposite side of the machine. When one frame is completed, the machine is swung 180 degrees and is ready to start welding another unit. This design saves about 400% in manufacturing costs.

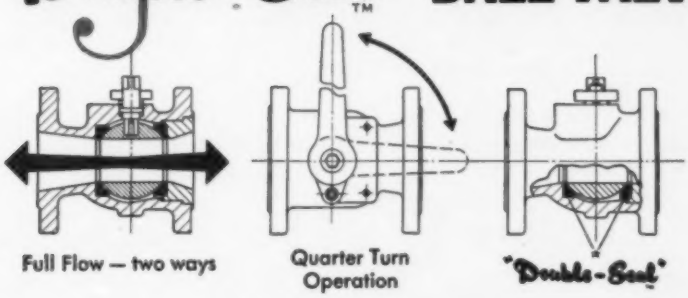
FLUID MOTOR ***A*** controls welding head motion along the traverse arm. Motor ***B*** rotates the turret and sweeps it across the work. As the welding head moves with respect to turret center, the turret motor is continually fed corrective signals and accelerates or decelerates the turret depending on whether the welding head is working on a progressively larger or smaller radius.

For example, as the welding head slowly sweeps from **C** to **D**, the traverse motor moves toward center, and the turret motor gradually slows down as the welder's working radius becomes smaller. From **D** to **E** the opposite happens and the turret motor speeds up. This way the welder travels at a constant speed, a prerequisite for laying down a strong, even weld.

Close-up of Industry's MOST VERSATILE BALL VALVE



jamesbury "Double-Seal" BALL VALVES



MATERIALS

Jamesbury "Double-Seal" Ball Valves are available in Types 303, 316 and Alloy 20 Stainless Steels, Carbon Steel, Bronze, Ductile Iron, Monel, Aluminum and PVC. Other materials on special order.

Interchangeable seats and seals are available in "Teflon", Nylon, Buna-N, Neoprene, Special Teflon compounds, and natural rubbers.

Pneumatic, Hydraulic and Electric Motor Operators to fit Remote Control Requirements.

SIZES

Screwed End: ¼" through 3".

Flanged:
150# series—½" through 12"
300# series—½" through 8"*
*10" and 12" on application
*600# series on application

Ask for complete "Double-Seal" Ball Valve Literature.

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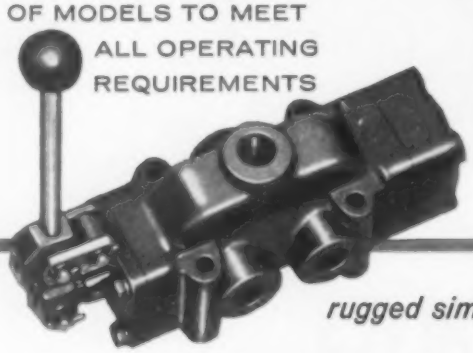
ADEL...offers you *single source* responsibility

for precision hydraulic control valves

4-WAY SELECTOR VALVES IN A VARIETY OF MODELS TO MEET ALL OPERATING REQUIREMENTS



a complete line for every application

GENERAL SPECIFICATIONS

FLUID: Oil, for hydraulic use only.
PRESSURE: 1500 psi maximum.
FLOW: 3 to 28 gpm.
PORT SIZES: ¼ to 1" pipe size.
MATERIAL: Slides and spools—hardened steel; bodies—gray iron castings.
Various forms of return springs or detents for slide positioning.

MODELS

Lever-Operated For Hand Control. Stem-Operated For Remote Manual Control.

Solenoid-Operated in Various DC and AC Voltages.

Pilot-Operated For Remote Hydraulic Control.

rugged simplicity for efficient, long, reliable service life

These compact, 4-way selector valves are used for control of double acting, or single acting cylinders. Simple spool-type construction provides a wide variety of porting arrangements for either open-center or closed-center hydraulic systems.

The Valves With Maximum Operating Efficiency Over The Years
***Let ADEL be your* single-source *for* precision hydraulic equipment**
Write for valve brochure containing complete specifications.

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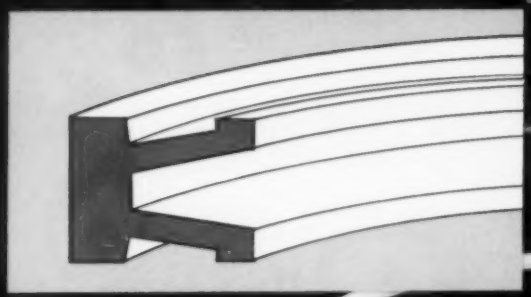
Haskel

METALLIC STATIC FACE SEALS

Patent Pending

The "Cadillac" of Static Seals



HS4 SERIES – Standard
HS14 SERIES – External Pressure
HS174 SERIES – Miniature
Specials available for difficult applications.

Designed and manufactured to meet the high pressure and extreme temperature requirements of systems in missiles and high performance aircraft.

APPLICATION

Wherever STATIC SEALING problems exist which elastomers cannot solve, the HS SEAL can be utilized to provide zero leakage at temperatures from –450°F to +2000°F and pressures to 20,000 psi. Liquids and gases are sealed in valves, actuators, engines, couplings, filters, etc. where temperature, vibration, pressure and expansion are critical.

RE-USABLE
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NO STORAGE OR AGE LIFE PROBLEMS
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LARGE DIAMETERS AVAILABLE
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SUPPLIERS OF O-RINGS, V-RINGS, U-CUPS, ROTARY SHAFT SEALS, METAL O-RINGS, MOLDED SPECIALTIES, SPECIAL SEALS

DESIGN

HS SERIES SEALS incorporate an integral spacer which avoids the problem of controlling groove depth closely. Installation is accomplished by merely indexing the seal to one mating surface and bringing the opposing surface against the seal. High torque loading is normally not required. Approximately 20 lbs. per inch of circumference is usually sufficient. Special seals may require more or less. Design strength necessary to contain unit pressures usually provides adequate force to seat the seal for proper performance. In operation, this design allows for thermal expansion up to .003 of an inch.

The sealing faces are generally located at the minimum possible diameter, thus insuring the minimum separation force on the flange. Since the seal is an unbalanced pressure design, tending to separate its sealing legs, higher pressure merely makes for better unit sealing force and any separating tendency of the flange is more than compensated for by the sealing legs which will follow the flange.

The mating surface should have a FLAT finish of 32 RMS or better for fluids, 16 RMS or better for gases, except for helium which requires 2-8 RMS.

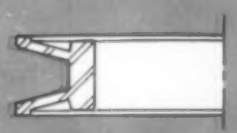
MATERIALS

HS4 and HS14 SERIES seals are manufactured from heat treated INCONEL X and SILVER PLATED AS STANDARD. They are lapped to provide flatness and smoothness of the sealing faces. HS 174 Miniatures are a "U" section made from 17-4PH bar stock in the hardened condition and SILVER PLATED AS STANDARD.

Any of the standard design HS seals or specials may be obtained in any of the following materials: INCONEL X, age hardened; A-286, age hardened; 17-4PH to H1150 hardening; 7075-T6 Aluminum; 18-8 CRES, heat treated; TANTALUM, annealed.

Most of these may be obtained with platings of SILVER, GOLD, INDIUM, TEFLON, KEL-F, COPPER, etc.

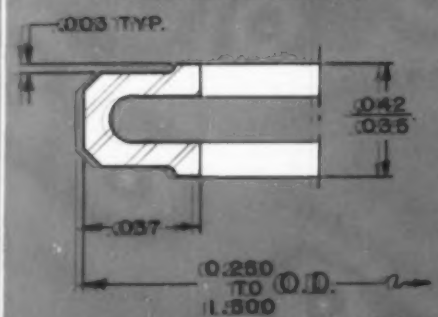
INSTALLATION DETAILS



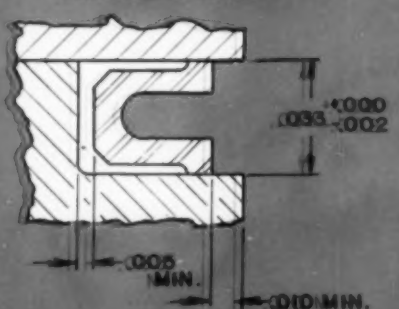
HS14 SERIES

NOTE: THIS SERIES IS DESIGNED FOR EXTERNAL PRESSURE APPLICATIONS. DIMENSIONS IDENTICAL TO HS-4 — EXCEPT FOR REVERSAL

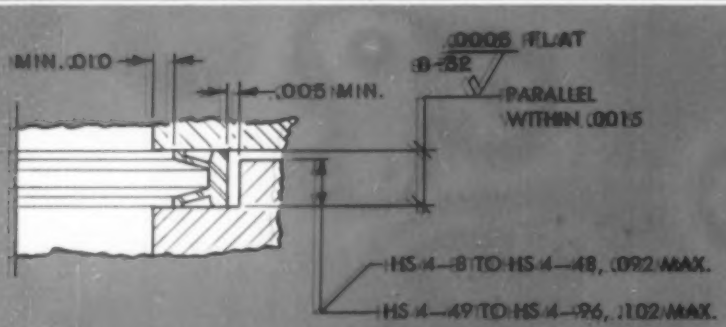
SEAL DIMENSIONS



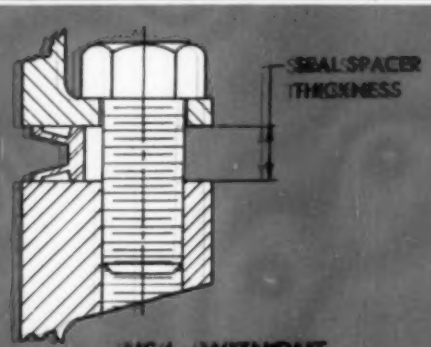
INSTALLATION



HS174 SERIES
MINIATURE



HS4—IN GROOVE

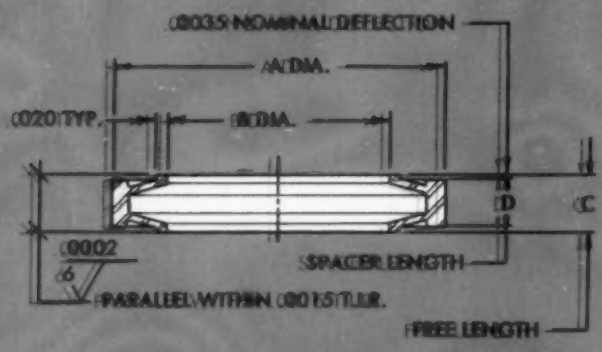


HS4—WITHOUT GROOVE

Haskel

ADVANTAGES

- EASILY INSTALLED
- RE-USABLE
- HIGH TEMPERATURE -- 2000°F
- HIGH PRESSURE -- 20,000 PSI
- LOW TEMPERATURES -- -450°F
- LOW PRESSURE — VACUUM
- LOW INSTALLATION TORQUE REQUIRED
- INTEGRAL HEIGHT CONTROL



HS4 SERIES SEAL

HS4 SERIES

PART NO.	A ±.003	B ±.003	C NOM.	D ±.002
HS4–8	.500	.300	.096	.090
HS4–9	.563	.363		
HS4–10	.625	.425		
HS4–11	.688	.488		
HS4–12	.750	.550		
HS4–13	.813	.613		
HS4–14	.875	.675		
HS4–15	.938	.738		
HS4–16	1.000	.800		
HS4–17	1.063	.863		
HS4–18	1.125	.925		
HS4–19	1.188	.988		
HS4–20	1.250	1.050		
HS4–21	1.313	1.113		
HS4–22	1.375	1.175		
HS4–23	1.438	1.238		
HS4–24	1.500	1.300		
HS4–25	1.563	1.363		
HS4–26	1.625	1.425		
HS4–27	1.688	1.488		
HS4–28	1.750	1.550		
HS4–29	1.813	1.613		
HS4–30	1.875	1.675		
HS4–31	1.938	1.738	.096	.090
PART NO.	A ±.005	B ±.005	C NOM.	D ±.002
HS4–32	2.000	1.800	.096	.090
HS4–33	2.063	1.863		
HS4–34	2.125	1.925		
HS4–35	2.188	1.988		
HS4–36	2.250	2.050		
HS4–37	2.313	2.113		
HS4–38	2.375	2.175		
HS4–39	2.438	2.238		
HS4–40	2.500	2.300		
HS4–41	2.563	2.363		
HS4–42	2.625	2.425		
HS4–43	2.688	2.488		
HS4–44	2.750	2.550		
HS4–45	2.813	2.613		
HS4–46	2.875	2.675		
HS4–47	2.938	2.738		
HS4–48	3.000	2.800	.096	.090
HS4–49	3.063	2.863	.106	.100
HS4–50	3.125	2.925		
HS4–51	3.188	2.988		
HS4–52	3.250	3.050		
HS4–53	3.313	3.113		
HS4–54	3.375	3.175		
HS4–55	3.438	3.238	.106	.100
PART NO.	A ±.007	B ±.007	C NOM.	D ±.002
HS4–56	3.500	3.300	.106	.100
HS4–57	3.563	3.363		
HS4–58	3.625	3.425		
HS4–59	3.688	3.488		
HS4–60	3.750	3.550		
HS4–61	3.813	3.613		
HS4–62	3.875	3.675		
HS4–63	3.938	3.738		
HS4–64	4.000	3.800		
HS4–65	4.063	3.863		
HS4–66	4.125	3.925		
HS4–67	4.188	3.988		
HS4–68	4.250	4.050		
HS4–69	4.313	4.113		
HS4–70	4.375	4.175		
HS4–71	4.438	4.238		
HS4–72	4.500	4.300		
HS4–73	4.563	4.363		
HS4–74	4.625	4.425		
HS4–75	4.688	4.488		
HS4–76	4.750	4.550		
HS4–77	4.813	4.613		
HS4–78	4.875	4.675		
HS4–79	4.938	4.738		
HS4–80	5.000	4.800		
HS4–81	5.063	4.863		
HS4–82	5.125	4.925		
HS4–83	5.188	4.988		
HS4–84	5.250	5.050		
HS4–85	5.313	5.113		
HS4–86	5.375	5.175		
HS4–87	5.438	5.238		
HS4–88	5.500	5.300		
HS4–89	5.563	5.363		
HS4–90	5.625	5.425		
HS4–91	5.688	5.488		
HS4–92	5.750	5.550		
HS4–93	5.813	5.613		
HS4–94	5.875	5.675		
HS4–95	5.938	5.738		
HS4–96	6.000	5.800	.106	.100

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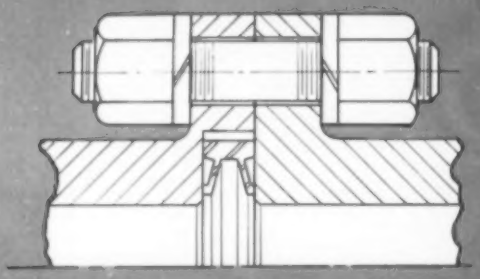
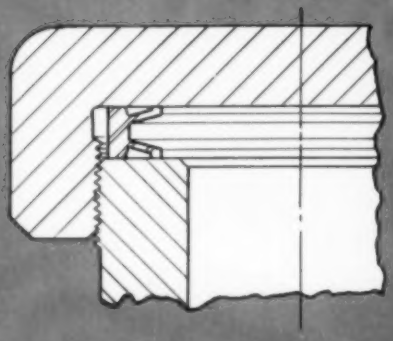
TYPICAL INSTALLATIONS AND SPECIAL DESIGNS

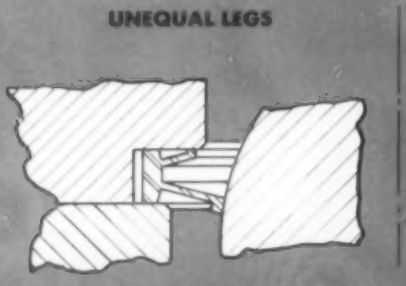
BOLTED FLANGES



THREADED CAP

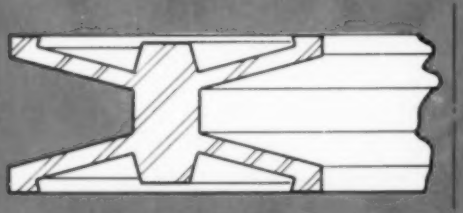


UNEQUAL LEGS

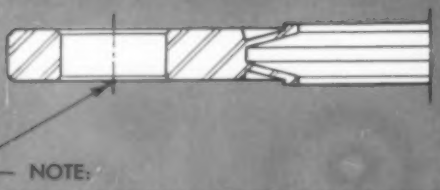


NOTE: LIP SEALS FOR BALL AND BUTTERFLY VALVES, ETC.

DUAL △ PRESSURE

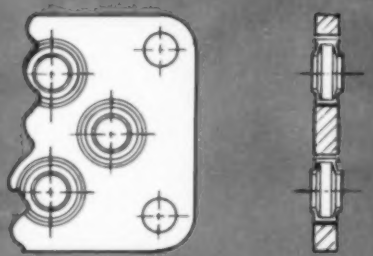


INTEGRAL BOLT CIRCLE SPACER



NOTE:
DRILLED TO MATCH MOUNTING BOLT PATTERN.

HOLE PATTERN MOUNTING PLATE



NOTE: MOUNTING PLATE BORED TO MATCH PORT PATTERN.

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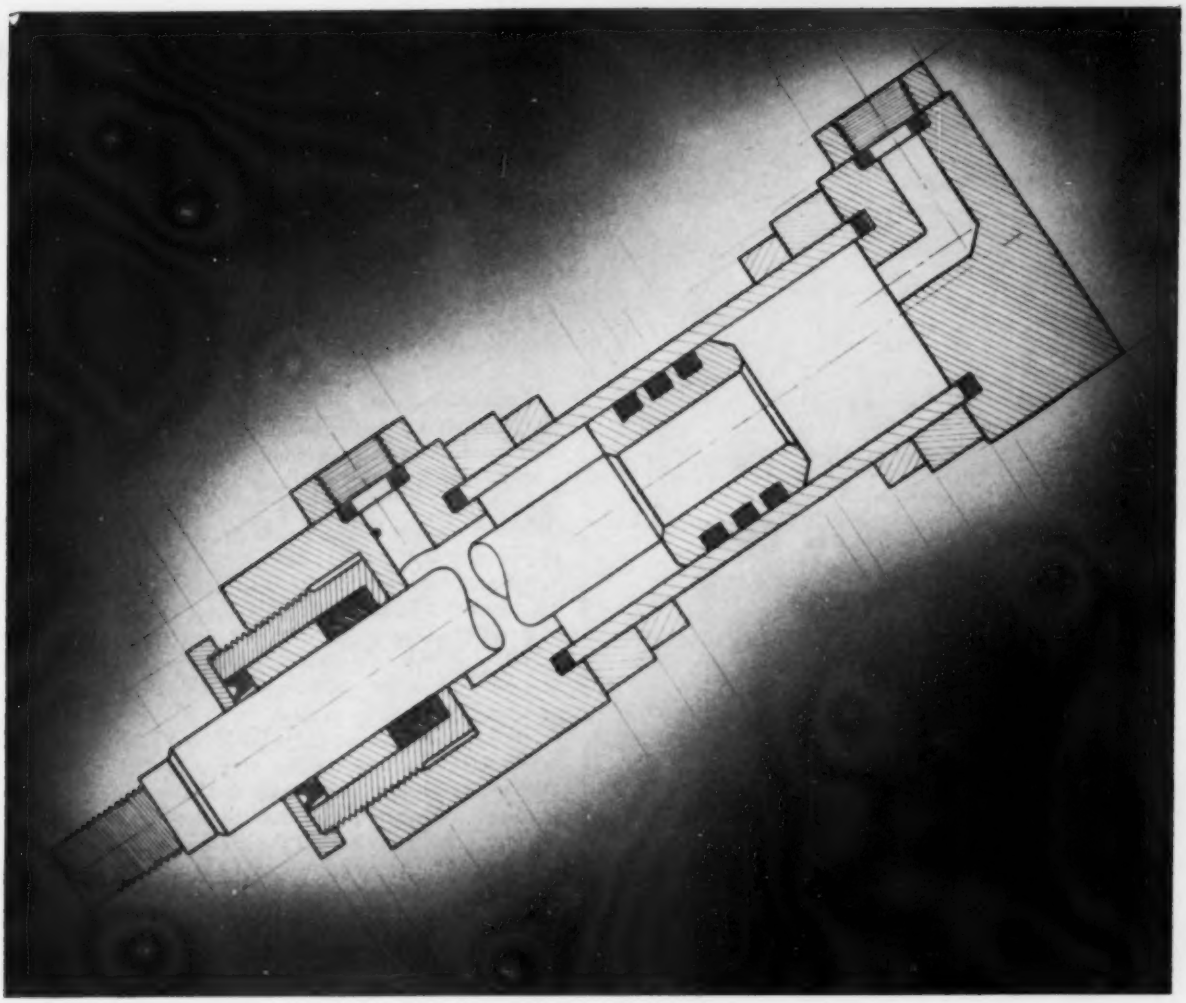

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The efficiency and reliability of hydraulic-power cylinders is boosted by the use of Du Pont TEFLON TFE resins in a variety of sealing applications. In the typical cylinder shown above, seals, V-ring packing, piston and wiper rings all take advantage of the unique properties of TFE resins. For one thing, TFE resins can handle all hydraulic fluids, whether of the fire-resistant type or the mineral-based oil type. For another, the extremely low coefficient of friction of TFE resins makes lubrication unnecessary, even in pneumatic applications. And TFE resins assure longer life through low cylinder-wall wear—in most cases, wear is substantially less than with any other sealing material. In packings, too, TEFLON TFE resins reduce leakage and maintenance problems.

Even if your next sealing problem does not involve tough operating conditions, it will pay you to consider the increased reliability and longer, trouble-free life offered by seals of TFE resins. Write for additional data to: Polychemicals Department HP-5, Room 2526T, Nemours Bldg., E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Delaware.

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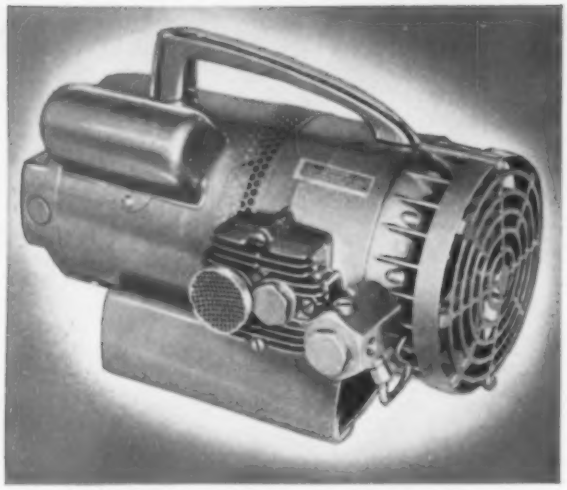

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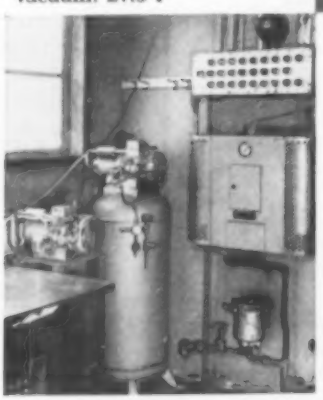

Typical application to air drier

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ITALY

Hydraulic shaves

AS STEEL ingots cool and solidify, impurities and foreign particles migrate to the surface. These must be removed before the ingot can proceed to its next operation, such as a rolling mill. This cleaning process is called *conditioning*.

Conditioning used to be done by hand with hammers and chisels. Later, pneumatic chipping hammers were used. Now, conditioning is done mechanically with billeters or gougers which are modified planers or millers.

In a hydraulic billeter made by the Innocenti Co. in Milan, a hot ingot (1200 C) is loaded on a conveyor and moved to the transfer table. The transfer cylinder extends, and pushes the ingot onto the crossfeed table where it is positioned and clamped. The crossfeed cylinder then feeds the ingot past an electric motor driven miller which shaves off the scales, tears, and heavy slivers.

The crossfeed table returns the ingot to the transfer table where the ingot holding clamps are released. A turnover cylinder rotates the ingot 90 degrees and the process is repeated to condition the second face. When all four sides are cleaned, the transfer table returns the ingot to the conveyor where it is unloaded.

The billeter has a separate pumping system for the heat exchanger circuit. System temperature is regulated by a temperature control valve in the heat exchanger's water line. Flow through the valve is controlled according to temperature at a bulb in the reservoir.

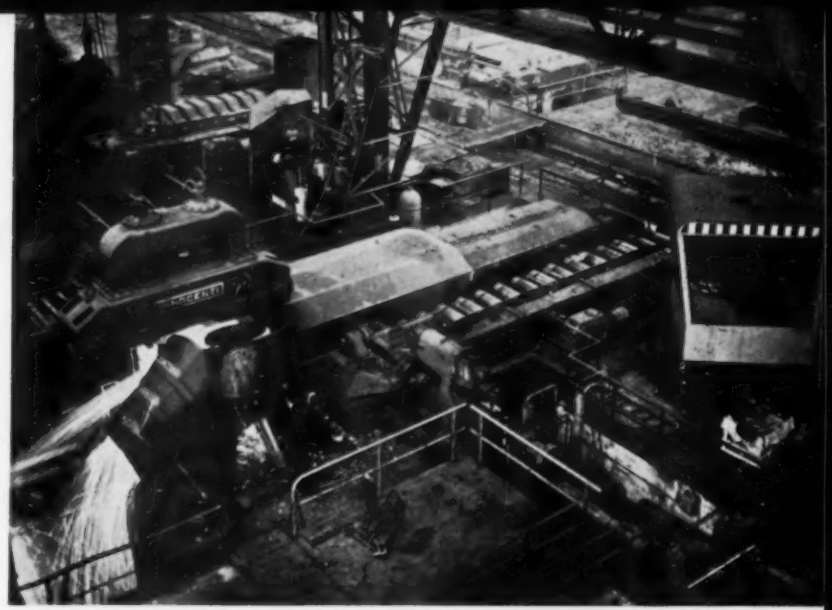
A sequence valve controls flow to the ingot positioning and clamping cylinders on the crossfeed table. This arrangement insures that the ingot is properly positioned and secured before the crossfeed table feeds it past the milling head.

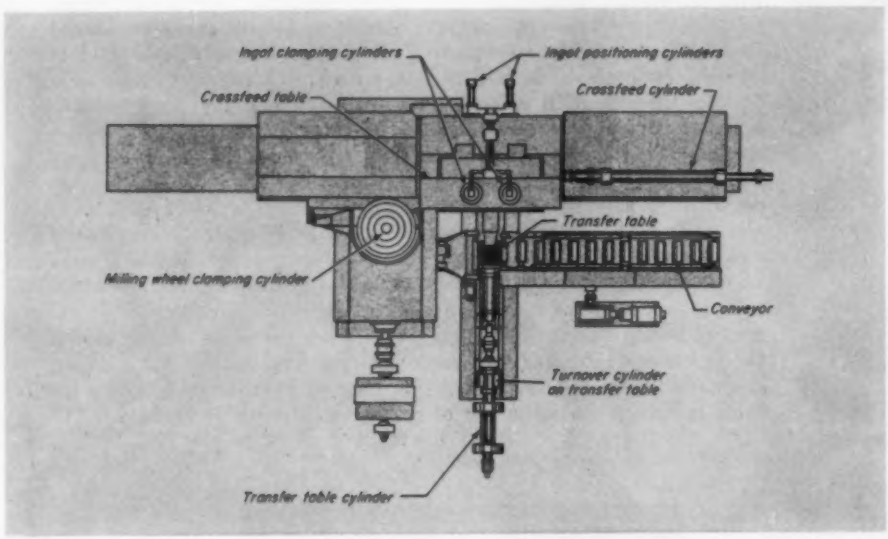
• **Relief Pressure Selection**—In the crossfeed circuit, a pilot-operated relief valve has its vent line connected through a 3-position, solenoid-actuated directional valve to a secondary relief valve. When the 4-way valve is in neutral, the pilot-operated relief valve controls circuit pressure. When the vent line is connected to tank, the pilot-operated relief valve acts as an unloading valve, dumping oil directly to reservoir. When the vent line is connected to the secondary relief valve, spring setting in the latter controls circuit relief pressure. Spring setting in the secondary relief valve must be lower than the pilot-operated relief valve.

Movement of the crossfeed cylinder is controlled by five limit switches which allow the ingot to approach the milling head rapidly, and slow down as the ingot is being shaved. On the return stroke, the ingot passes the milling head slowly, speeds up for most of the return stroke, and finally slows down before it comes to a stop in front of the transfer table. ▼▼▼

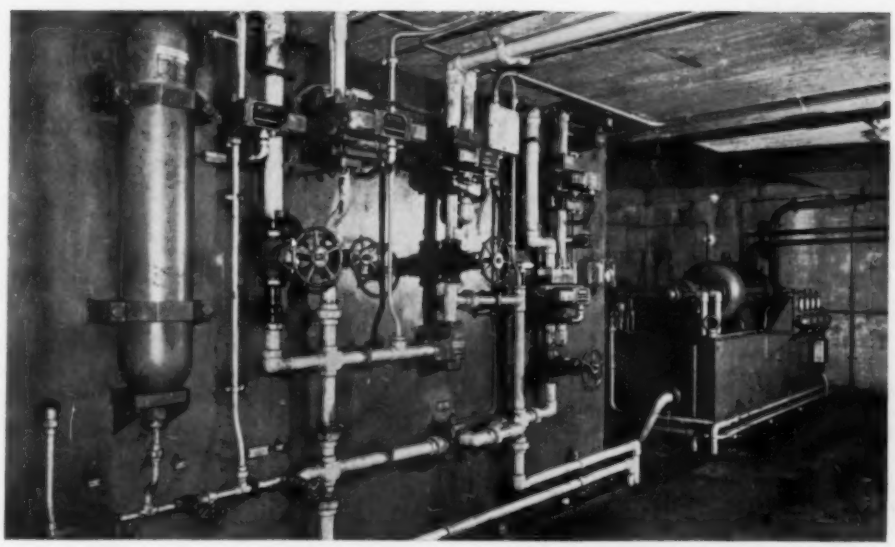
miller steel ingots

• By **A. PALERMO**, *General Managing Director Vickers SPA., Subsidiary of Vickers, Inc., Div. Sperry Rand Corp., Milan, Italy*





HOT INGOT (1200 C) is moved on roller conveyor to transfer table from which it is pushed onto crossfeed table. After it is properly positioned and clamped, the ingot is fed past milling head where it is shaved, as illustrated above.

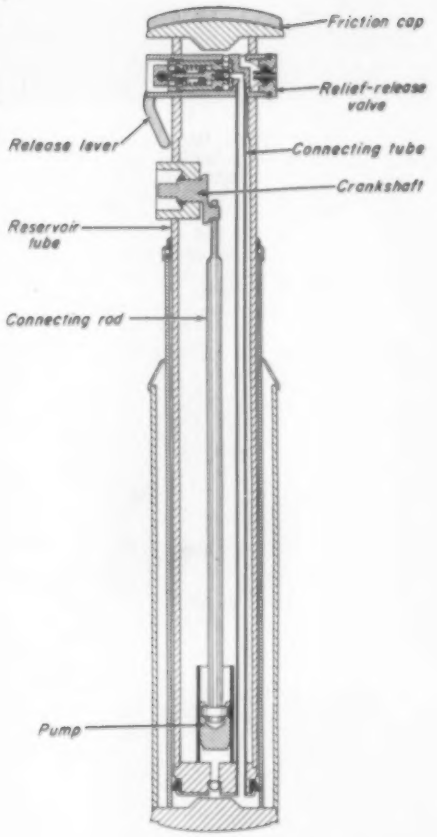


HYDRAULIC COMPONENTS are installed in a basement below the machine. Bladder accumulator (left) has sufficient fluid to maintain pressure on the milling tool clamp cylinder in an emergency. Control valves are solenoid actuated. Two electric drive motors (110 hp) and four double pumps are mounted on 1200-gallon reservoir at right. System capacity is 320 gpm at an operating pressure of 1000 psi.

ENGLAND

Hydraulic props brace exhibition floor

• By JOHN A. LANKESTER, *European Editor*



PIT PROP is extended by small internal pump operated by a crank. It extends the prop by pumping fluid from the reservoir tube, through a port in the piston, to the chamber under the piston. A check valve, built into the piston, prevents reverse flow. A tube connects a relief-release valve with the chamber under the piston. Maximum lifting force of the prop is limited by the relief valve setting.

To remove the prop, a release lever is actuated. The lever lifts the relief valve off its seat relieving pressure under the piston. The prop can be released remotely by attaching a lanyard to the release lever.

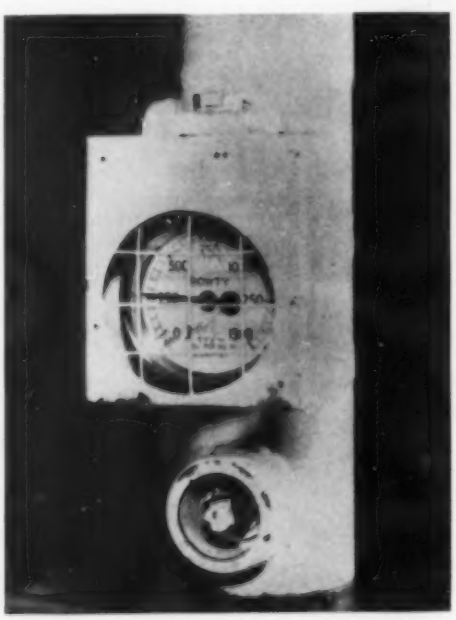
WHEN the owners of Olympia (a prominent exhibition hall in London) accepted the recent Royal Dairy Show, they took on a problem that would make most exhibition hall owners shudder.

One of the exhibitors planned to erect a 100-ton pre-fabricated farm building on the exhibition floor. To keep the exhibit from landing in the basement, the exhibition floor obviously needed additional support. To add to their problem, the supports couldn't be permanently installed, because the basement is needed for storage between shows.

Word of their predicament reached Dowty Mining Equipment, Ltd., Gloucester, England who are experts in supporting heavy roof loads in mines. Certainly one of Dowty's 25 different hydraulic props ranging from 21 inches to 92 inches long would do the job.

After examining the hall, Dowty engineers recommended one of their standard hydraulic props with a 28-inch extension welded to one end to reach the 10-foot ceiling. A number of props were placed under the huge exhibit. Pressure gages were installed on the props to indicate the internal oil pressure. With pressure readings, lifting force of each prop could be calculated. This allowed the support to be distributed evenly and prevented lifting the entire hall off its foundation.

When the props are not needed for bracing the exhibit hall floor, they are kept in racks, leaving the basement clear for storage. ▼▼▼



PRESSURE GAGE attached to the prop indicates the oil pressure acting on the piston to extend the prop. The gage reading in psi multiplied by the area of the piston gives the total lifting force.

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AEROSPACE SECTION

Fluid Systems For Flight and Ground Support

Gas Servo Has Hydraulic Response Characteristics

A new design in gas servo controls by Weston Hydraulics, Ltd., Van Nuys, Calif., gives gas servo systems the desirable performance characteristics of hydraulic control systems: fast forward response, and positive reverse stiffness. Yet this servo operates far beyond the environmental limits of hydraulics. It was developed for use at temperature extremes and in space or nuclear environments. The system has three basic components—the gas actuator for either hot or cold gases, a servovalve, and a feedback system with a simple mixing network.

By eliminating pumps and pump drives, the gas servo system can save more than 50% of the weight of a similar hydraulic system. With fewer components and no elastomeric seals, it has a long storage life and increased reliability.

Cryogenic Insulation Has Low Conductivity

A new type of synthetic, calcium silicate offers lower conductivity values than materials currently in use. This insulating fill offered by Johns-Manville Celite Division is a free-flowing powder, free of explosion or fire hazard and compatible with commonly used liquid gases such as oxygen and hydrogen. Its thermal conductivity is 0.100 Btu/in.-hr-sq ft-°F as determined between liquid nitrogen and ambient temperature at atmospheric pressure. Its loose weight density is 4½ to 6 lb/cu ft.

Kohler Develops Clean Room for Valves

Precision valves for aircraft and missiles are cleaned, assembled, and tested under dust and dirt free conditions in a Clean Center developed at the Kohler Co., Kohler, Wisconsin. All air entering the Center has dust removed by an electronic air cleaner. The temperature is kept at 68 F by an air conditioner which also controls humidity and maintains a slightly positive air pressure. This prevents dust from entering when the door or a window is opened. Valves and parts entering the Center are degreased in boiling trichloroethylene followed by ultrasonic cleaning. Then the valves are assembled, tested, inspected, and flushed for five minutes with a preservative oil to remove any metal flakes which might have been released from the testing equipment. Valves for missiles are heat sealed in individual airtight containers.

For more news about fluid systems see page 142

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UNDERSTANDING CONTAMINATION

Effects on servovalves

• By H. D. DAVIS,
Design Group Engineer, Hydraulics Group, Convair Astronautics Division, General Dynamics Corp., San Diego, California

With all the other performance objectives, a servovalve's design depends on its reaction to contamination. This second article examines basic servovalve designs to find out what the critical factors are.

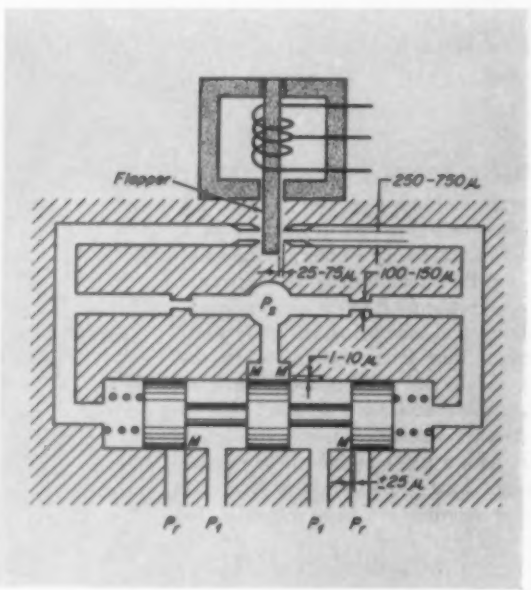
CONTAMINATED hydraulic fluid affects servovalve performance because it disrupts the valve's normal force balance, flow rates and paths, and mechanical and electrical operations. How the valve reacts depends not only on the valve's design and filters, but also on the nature and extent of contamination. We shall examine how contamination affects the first and second stages of three basic servovalves. The three types of valves are jet pipe, single nozzle, and dual nozzle, including parallel dual nozzle. A great variety of these and other first stage designs are available.

FIRST STAGE HYDRAULIC CIRCUIT

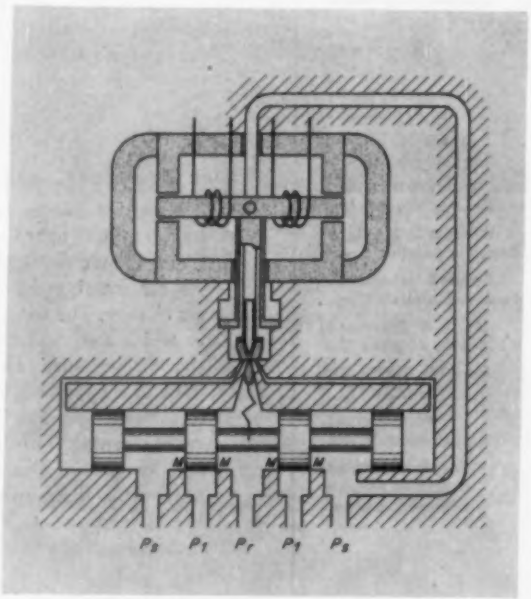
• **Dual Nozzle**—The dual nozzle, first stage has two parallel, balanced circuits with fixed and variable orifices, and a nozzle-flapper common to both circuits. Because clearances and flow rates are small, and balance between the circuits is essential, as many as three filters (usually sintered metal type) are used in each branch.

Depending upon the number of filters used, they may be located as follows:

- One common filter for the complete first stage circuit.
- Upstream of each fixed orifice.
- Upstream of both the fixed orifices and the nozzles.
- At the entrance of each branch and upstream of each fixed orifice and each nozzle.



DUAL NOZZLE SERVOVALVE shows typical clearances in microns between moving parts. *M* indicates flow metering.



JETPIPE SERVOVALVE positions the main spool with flow from the swiveling jetpipe.

PART 2

- Combinations of common filters and individual filters.

If either fixed orifice or the upstream branch filters clogs, the main spool moves hard over in that direction, because of reduced pressure on that end of the spool. If one nozzle or its associated filter clogs, the main spool goes hard over in the opposite direction because of increased pressure.

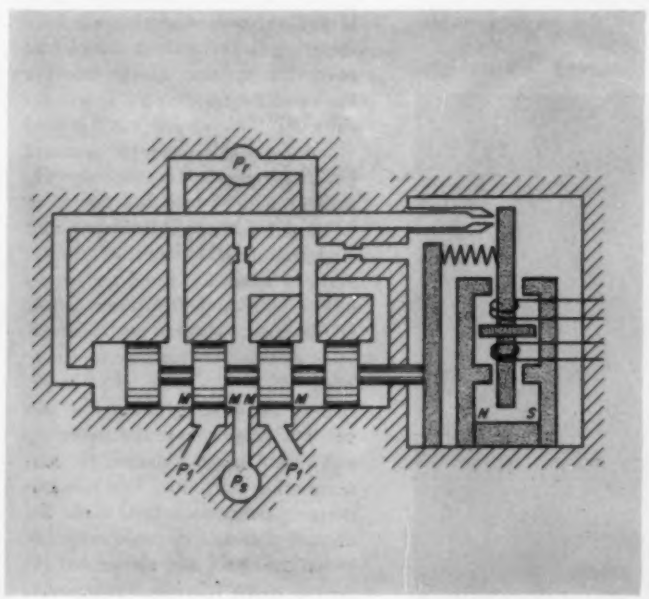
If both fixed orifices or upstream filters clog simultaneously, control of the second stage spool is lost because of low, main spool, end pressures. Finally, if both nozzles clog simultaneously, loss of control and hunting of the main spool results, because of high spool-end pressures. These effects are not necessarily absolute, but may occur by degrees. Unbalanced, partial contamination results in null shift of the spool; balanced partial contamination results in sluggishness and low frequency response.

• **Parallel Dual Nozzle**—A variation of the dual nozzle servovalve is formed when a horizontal bar is added to the torque motor armature and the nozzles are turned 90 degrees. The dual nozzles are parallel to the center line of the torque motor, either above or below the flapper. Clogging of nozzle-flapper opening (the smallest in the circuit) can be relieved by axial motion of the armature-flapper assembly, with only a transient disturbance of the valve's balance. Null shift may still occur by unsymetrical nozzle clogging. Clogging of fixed orifices will cause failure as in the conventional, dual nozzle first stage. The effectiveness of this design is supported by test data reported in WADC Report 55-29, Part VI. However, other factors such as first stage flow rate and second stage design enter into the overall contamination tolerance of a servovalve.

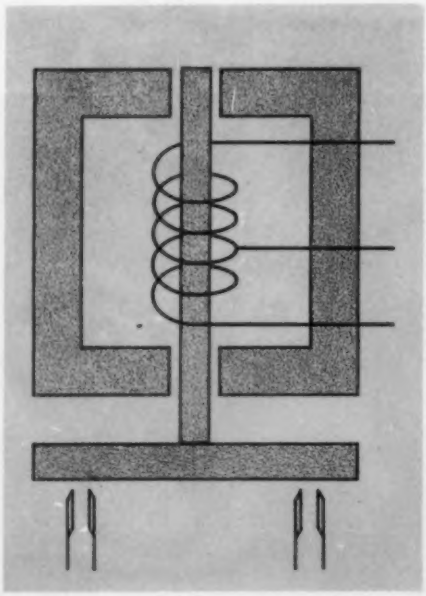
• **Single Nozzle**—With single nozzle design, pressure is controlled on one end only of the main spool. Spool balance is maintained by applying supply pressure to a smaller piston area at the opposite end of the spool. Spool position feedback is ob tained by the spring level system rather than spring centering.

Single nozzle design gives three advantages. First, all clearances can be doubled for first stage flow equal to dual nozzle flow. Consequently, filters can have larger pore sizes. Second, circuit unbalance due to contamination of one branch is avoided, because nearly stagnant supply pressure is applied to the small piston area. Finally, the mechanical feedback linkage between the flapper and the spool tends to move the flapper away from the nozzle as the opening clogs. This permits the opening to clear itself by a positive mechanical force with only a transient effect on the valve.

• **Jet Pipe**—The jetpipe is swiveled by the torque-motor. This positions the main spool by controlling spool-end pressures with stagnation pressure resulting from flow from the jetpipe. The contamina-



THIS SINGLE NOZZLE SERVOVALVE controls pressure at one end only of the main spool.



PARALLEL, DUAL NOZZLE FIRST STAGE. Axial motion of the nozzle flapper relieves clogging.

tion advantage is that there is no opening in the first stage circuit smaller than 200 microns, and very smooth passages may be used. This level of contamination can easily be handled by present filtration equipment.

• **Filter Design**—To keep servovalves light, the first stage filters should be small. Sintered metal elements are most commonly used. They are usually cylindrical, about 1/8-in. in diameter and 3/8-in. long. A bit larger surface area results from blind coring the inside of the cylinder and presenting the outside surface to fluid flow. However, the results generally are the same. The filter is just as likely to clog as the orifice it protects.

Media migration of this type of element must be recognized. Frequently, valve manufacturers place a woven wire screen downstream of the filter element to trap wandering filter media.

System filters are both necessary for efficient operation and required by military specifications. System filters can assume a large part of the burden of the first stage filters, if they are of a finer rating than the servovalve filters. At Convair Astronautics and many other airframe manufactuers, large, finely rated filters are built into the servo-actuator assembly to obtain the best possible filtration for each servovalve.

• **Fibers Build Bird's Nests**—Fibrous contaminants are the most treacherous to the first stage circuit. The opening between nozzle and flapper is the smallest opening in the first stage. Also, there is a 90-degree change in flow direction at this point. This situation is particularly vunerable to fibrous contaminants. Quite often fibers work through upstream filters without seriously affecting operation. They are caught at the 90-degree bend and/or by small burrs on the nozzle opening. These burrs are caused by brinnelling by the flapper or by poor manufacturing operations. The fibers build a "bird's nest" which snares other particles to slow or stop fluid flow. Therefore, any paper or cloth product, from wiping materials to poorly made paper filters that will deposit fibers in the hydraulic system must be avoided. Once fibers get into the hydraulic system, it is nearly impossible to remove them.

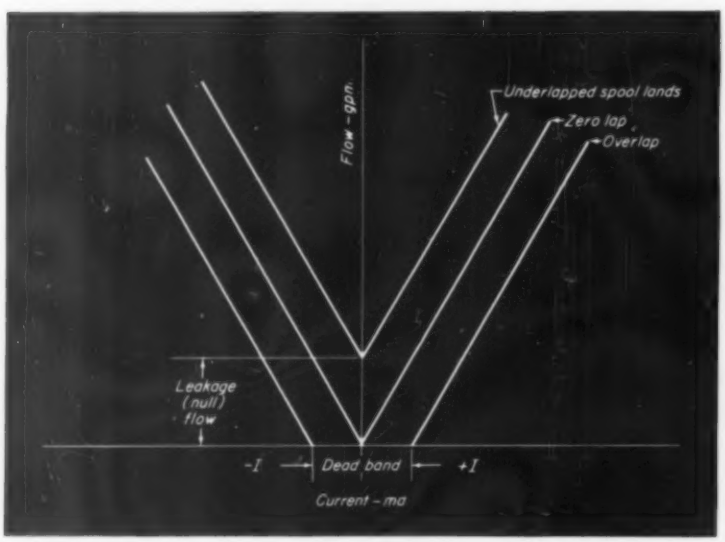
SECOND STAGE HYDRAULIC CIRCUIT

The servovalve's second stage controls rate and direction of main fluid flow to the servo actuator. The most commonly used second stage system is the spool type, 4-way valve. Design variations are mainly in the number of lands and spool diameters and fits. Many other second stage arrangements have been tried. Some have used rotating or sliding plates which align ports in the moving and stationary members. Others are variation of poppet types. These valves are not in general use because of manufacturing or performance difficulties.

The second stage spool is usually pressure controlled by the first stage. Spool position is determined by the force balance of nozzle pressure on the spool-end area and spring force as in the dual nozzle valve. Or, by feed back to the flapper as in the jet pipe and single nozzle designs.

• **Clearance Design**—Second stage diametral and axial clearances are extremely small. Large diametral clearances permit excessive leakage and consequent power loss. Flow metering is controlled by axial clearance at land edges. In the dual nozzle valve shown, both edges of the center land and the inside edges of the end lands meter flow. In the jet pipe and single nozzle valves shown, both edges of the inner lands meter flow. If the valve is underlapped (the metering land does not completely cover the opening in the sleeve), excessive leakage (null flow) results. If the valve is overlapped (the metering land more than covers the opening in the sleeve), leakage will be low, but the valve has a dead band. This means that a signal must be applied to the valve to move the spool the length of the overlap before output flow is obtained. The curves show effects of valve lap on flow and current.

Because these clearances are small 1-10 microns) they make the servovalve more sensitive to contamination particles. Any contaminant particle smaller than the diametral clearance could enter between the spool and sleeve and increase spool friction. Conversely, contaminants larger than this clearance cannot enter. The small



FLOW CURVES show how spool land-lap affects flow through the servovalve.

FIRST STAGE SERVOVALVE DESIGN MUST COMPROMISE THESE FACTORS

BALANCE THIS	AGAINST THIS
Flow rate should be . . .	
Small— to reduce the number of particles passing through the circuit.	**Large—** to obtain the best valve time constant.
Orifice size should be . . .	
Small— to reduce leakage and consequent power loss.	**Large—** to allow passage of small particles which are difficult to filter.
Filter pore opening should be . . .	
Small— to catch contaminants and avoid clogging of orifices.	**Large—** to avoid clogging the filter
Filter surface area should be . . .	
Small— to permit filter to be small and conserve weight.	**Large—** to prevent clogging.

spool lap openings permit silt to build up at each metering land. Most present filters cannot remove all contaminants of the size range under discussion without using oversized elements of heavily calendered media. However, there is an advantage in using a nominal 5-micron element with a valve of 10-micron diametral clearance. The filter reduces the chances of valve clogging because it removes 98% of the most troublesome particles, and only combinations of particles can cause clogging.

Only a limited advantage can be gained from using finer filtration, because in most cases, the number of particles in a fluid of, say, 0 to 1 micron will be much greater than the number of particles from 1 to 2 microns. If the curve of quantity versus sizes is steep enough, all benefits of finer filtration are lost because of the overwhelming number of small particles. By studying contaminant dimensions obtained from system samples the designer can determine if finer filtration is worthwhile.

It is a logical step to use as large a diametral clearance as possible, comensurate with the allowable leakage. Large clearance also permits the use of optimized overlap, since the diametral clearance, being the larger dimension, controls the particle sensitivity of the assembly.

• **Effect of Fibers**—Fibers are less important in the second stage than in the first stage. The long, narrow passage of the diametral clearance is a fairly effective, depth type filter. However, at the metering edges of the spool fibrous materials can be troublesome. But with strong spool-positioning forces electrical dither, this difficulty can be overcome easily.

• **Material Effects**—Materials of about the same hardness have the same effects on second stage operation. Some testing agencies have reported that metallic contaminants severely effect valve operation, while non-metallic contaminants do not. However, the metallic contaminants used in the tests were predominantly in the 0-5 micron range, small enough to enter the diametral clearance of the spool and sleeve. The non-metallic particles were in the 10-20 and 20-40 micron range, too large to enter the diametral clearance. The only effects of metals seem to be from those which are similar enough to the spool and sleeve materials to cause pressure welds between them, or from those very soft metals which smear over the parts, requiring high shear forces to move the spool.

• **Chemical Effects**—These can be very serious in the second stage. For instance, it is believed that the viscosity index improver used in MIL-H-5606 hydraulic fluid tends to trap colloidal particles. In a series of tests conducted by Convair Astronautics, dual nozzle valves were operated first with regular MIL-H-5606 fluid, then with a fluid containing no VI improver, but with a larger amount of sulfonate corrosion inhibiter. The regular fluid caused hysteresis to increase continuously because of the gumming effect of the VI improver. With the second fluid, sludge was flushed out of the valves, and they returned to their original hysteresis values. This was due to two things. First, no further acrylic was added to the valve. Second, the sulfonate corrosion inhibitor acted as a detergent to wash the valve clean.

The acrylic is flushed out because it is weakly polar. One end of its long molecular chain attaches to the internal, metal surface of the valve. The sulfonate is strongly polar, and when added to the fluid, displaces the weaker acrylic molecule. Fluid flow then flushes out the acrylic material.

• **Hardness**—A contaminant's hardness mainly affects its resistance to shear when trapped between the spool and sleeve. Undoubtedly, extremely hard materials embed in the metals and cause scratches as the spool moves through the sleeve. This effect can be considerably reduced by relieving the spool lands.

• **Suspension Characteristics**—The contaminant's suspension characteristics affect the valve during both operation and manufacture. In operation, the denser, less bouyant, often metallic particles are the most likely to cause silting. They may settle in the areas of slow moving fluid, then break loose under vibration or shock to clog the valve. In manufacture,

Continued on next page

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CONTAMINATION

Continued from page 139

these particles are most difficult to remove during cleaning.

• **Design Tolerance Into Second Stage**—Most engineers concede that it is clearly impossible to prevent small size contaminants from entering the small openings around the second stage spool. Once there, however, what can be done to reduce their effect?

In a series of tests to determine the effect of contamination on the second stage system, the Boeing Airplane Company obtained the following results:

> Valves with high spool-positioning force levels were less sensitive to contamination. Boeing found that if spool forces were large enough, valve hysteresis reached a limiting value, above which additional contamination had no further effect. This was found to be particularly true of the jet pipe and single nozzle servovalves. Their spool position is determined by feedback to the first stage, rather than being balanced by centering springs which nullify the pressure positioning force. Valves using the smallest contact area between the spool land and the sleeve are least susceptible to contamination. By undercutting or shortening the parts of the valve lands not used for metering and leakage control, the friction effects of contaminants are reduced. An enlarged clearance area is provided for relief of the contaminants. Low leakage levels can be maintained by the labyrinth effect. ▼▼▼

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Boeing Airplane Company (R. E. Osgood). A Realistic Hydraulic System Contamination Meter.

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Circle 49 →

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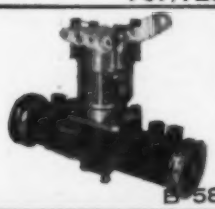
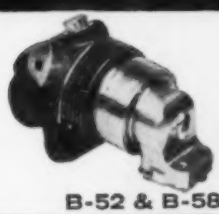


B-58

Some of the Units now in Production



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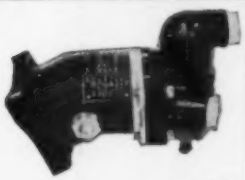

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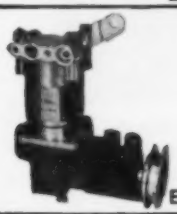

B-58

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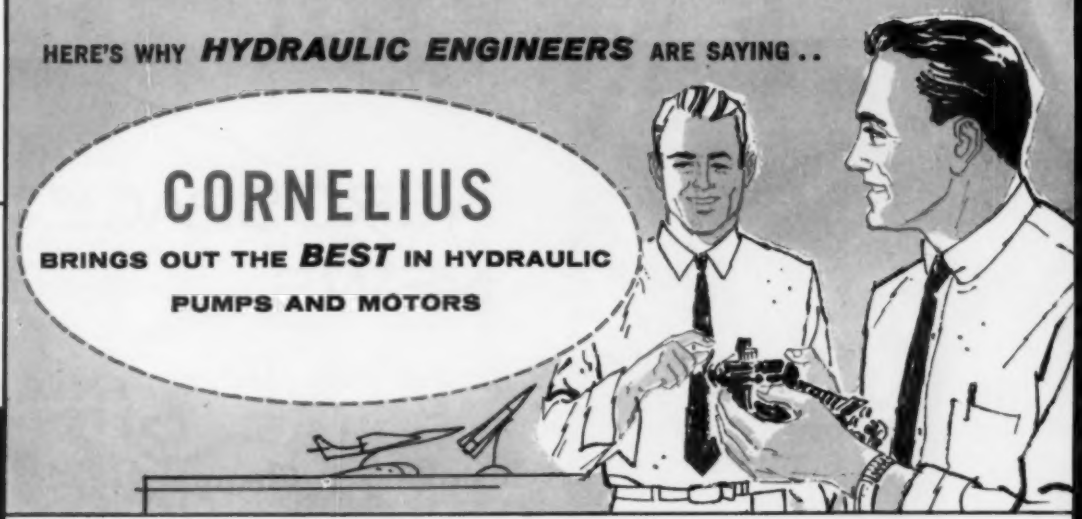

20 to 30% smaller size, 10 to 20% lighter weight – these are two good reasons why Cornelius hydraulic pumps and motors are the new Standard of Performance. Investigate further and you'll find more reasons why this is true. *Super-hardened* pistons; special hardened steel cylinder block; new, patented constant velocity ball joint design; improved mechanical face seal and higher capacity bearings are reasons why these units deliver *more horsepower per pound* than any other hydraulic units made. If you have a pump or motor application check the chart below. It helps explain why hydraulic engineers are specifying these units and saying "Cornelius brings out the *best* in hydraulic pumps and motors."

MODEL	HOUSING ANGLE	DISP. CU. IN. PER REV.	TORQUE AT 3000 PSI IN. LBS.	FLOW AT 3000 RPM GPM	MAXIMUM CONT. POWER AT 3000 RPM H.P.	MAXIMUM CONT. RATED SPEED R.P.M.	MAXIMUM INTER. R.P.M.	UNIT WEIGHT LBS.
4	30°	.04	19.1	.26	4.86	16000	23000	1.25
5	13.3°	.05	23.9	.325	4.55			
6	15.7°	.06	28.6	.390	5.45			
7	18.6°	.07	33.4	.455	6.36			
8	21.4°	.08	38.2	.519	7.26	12000	18000	1.75
9	24.12°	.09	43.0	.584	8.16			
10	27°	.10	47.7	.650	9.10			
11	30°	.11	52.5	.714	9.99			
12	23.5°	.125	60.0	.812	10.2	10800	16000	2.1
16	30°	.160	76.5	1.04	13.1			
20	23.5°	.200	95.5	1.30	14.5	9600	13800	3.0
25	30°	.250	120	1.62	18.1			
32	23.5°	.320	153	2.08	20.2	8400	11900	4.2
40	30°	.400	191	2.60	25.4			
50	23.5°	.500	239	3.25	26.9	7100	10200	6.6
64	30°	.640	306	4.16	34.5			
80	23.5°	.800	382	5.20	37.6	6200	8800	9.0
100	30°	1.000	478	6.50	47.0			
125	23.5°	1.250	600	8.12	53.0	5600	7600	12.0
160	30°	1.600	765	10.40	67.9			
200	23.5°	2.000	955	13.00	75.8	5000	6600	16.3
250	30°	2.500	1200	16.20	94.5			
320	23.5°	3.200	1530	20.80	99.5	4100	5300	23.5
400	30°	4.000	1910	26.00	124.0			

We call this new hydraulic design **high energy/low friction** because it delivers 92 to 93% efficiency at optimum speeds and pressures. All units are designed to meet MIL. P-19692 (AER), MIL. P-7858, MIL. M-7997-A, MIL. P-5954 and MIL. P-5994. Cornelius units are qualified for use in Type III (350° F.) Oronite, as well as Type II MIL-5606 (275° F.) and Type I (160° F.) Skydrol systems. Cornelius pumps and motors are used on B-52, B-58 and 707 aircraft. Other models are used for Pershing missile ground support operations and a new Cornelius designed, packaged hydraulic system for Air Force cargo winches.

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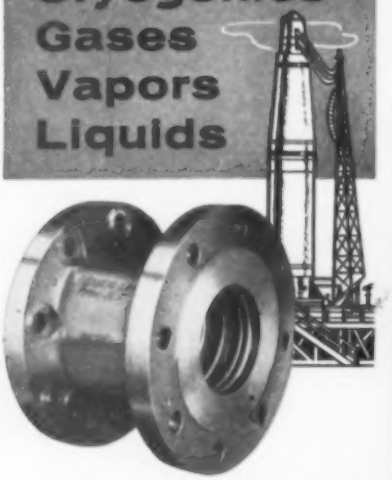

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AEROSPACE NEWS

from the fluid power field

Installing a Clean Propellant Loading System

PROPELLANT LOADING SYSTEM at the Naval Missile Facility, Point Arguello, Calif. View shows LOX storage tank, gaseous oxygen storage bottles, and pipes and valves housed in rectangular skids.

The propellant loading system at the Naval Missile Facility, Point Arguello, Calif., consists of hundreds of pipes, valves, lines, and tanks to control the flow of liquids and gases entering a missile's fuel tanks. Decontamination starts by performing a wipe test on all pipes, valves, lines and tanks when they arrive on site. The inner surface of each line or pipe exposed to liquid or gas is wiped with clean filter paper. After wiping, the paper is viewed under a microscope to determine particle size. If the equipment passes this test, it is checked for hydrocarbons with black light. Fluorescence indicates hydrocarbon particles are present, and the item must be returned to the cleaning room.

All air to the cleaning room is filtered. Personnel wear plastic gloves and caps. After articles are cleaned, they are again inspected by the wipe and black light tests. If satisfactory, a gaseous nitrogen positive purge is put on the item. Then it is sealed, tagged, and returned to the launch site.

During pipe installation, a positive pressure is maintained to keep the equipment clean. When the system is complete, a pressure test is conducted to insure against leakage and further contamination. If no leakage is found, the pipe lines

Continued on page 144

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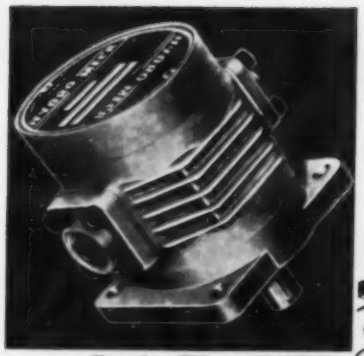

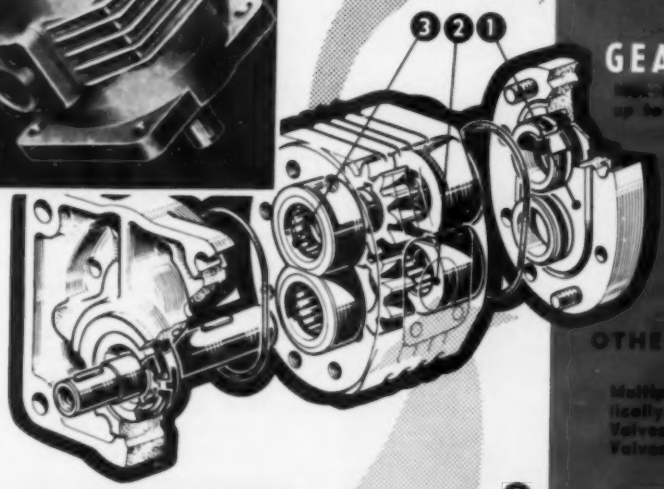

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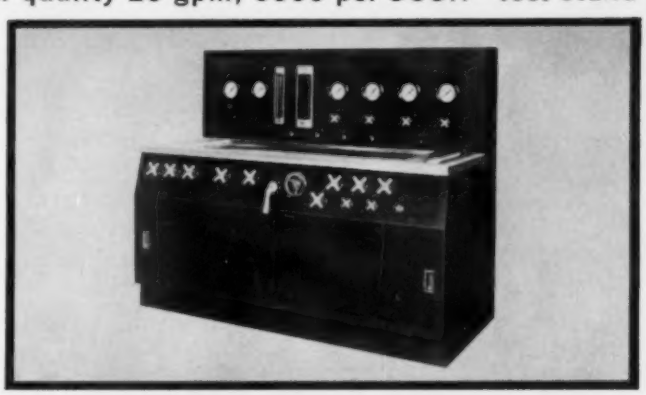

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SPECIFICATIONS

Flow	0-20 GPM @ 5000 PSI
Pressure	0-5000 PSI
Automatic Temp. Control	80°F to 350°F, ±2°
Hydrostatic Pressure	10,000 PSI
Pump	Variable volume
Fluid Filtration	10 Microns
Flow Meters	0-5 GPM, 0-20 GPM ±1%
Motor	75 HP @ 1200 RPM
Dimensions	84" Long, 35" Deep, 64" High
Finish	Epoxy Paint resistant to hydraulic fluids, fuels, and acids

May, 1961 Circle **6** on Reader Service Card **143**

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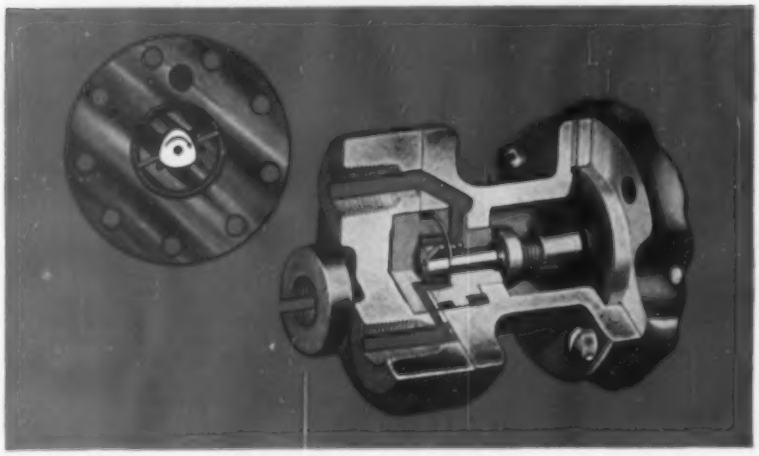

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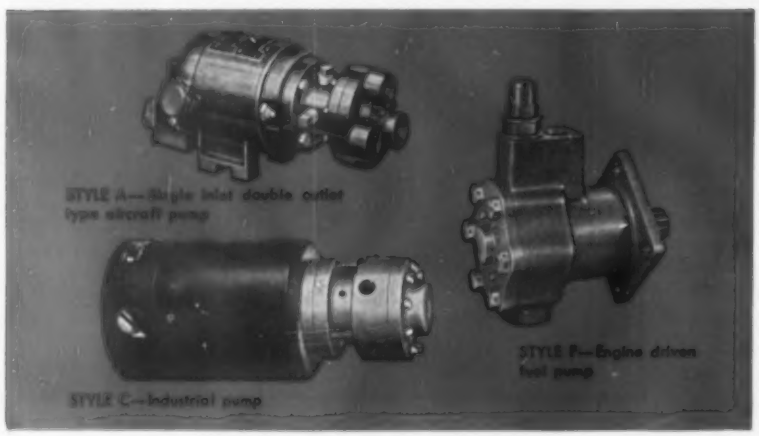

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AEROSPACE NEWS

from the fluid power field

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All fuel arriving at the launch site is inspected. If found unclean, it is pumped through filters.

TEST CREWMAN performs pressure tests on nitrogen piping in the propellant loading system.

The propellant loading system of Point Arguello, launching complex No. 1 is considered contaminated if 72 ppm of 150-micron particles are found. Prior to turning this Navy built missile facility over to the Air Force, tests showed only 2-3 ppm, and micron sizes, in most instances, were under 100. No particles greater than 150 microns were found.

You can win up to $500 by entering the 1961 FLUID POWER PRIZE PAPER CONTEST

For details circle 220 on reader service card

United Aero Products appoints Waivers

Paul F. Waivers has been appointed director of the environmental devices division of United Aero Products Corp., Burlington,

Continued on page 146

Circle **163** on Reader Service Card

TubeXperience in Action

9 REASONS TO CHOOSE SUPERIOR STAINLESS AIRCRAFT/MISSILE QUALITY TUBING FOR HYDRAULIC SYSTEMS

- Every length hydrostatically tested to recommended working pressure.
- Fully tested to assure flareability without surface notches or breaks.
- Controlled bending quality for ease of fabrication without distortion or fracture.
- Thoroughly cleaned to insure freedom from oxide film and foreign particles.
- Tolerances closer than generally required by industry specifications.
- Every length, down to 3/16 in. OD, indelibly marked with our name, specification, analysis, heat number and size.
- Certified test reports when required.
- Available in both seamless and Weldrawn® forms in Types 304, 321 and 347 stainless.
- Carried in stock by leading Steel Service Centers in sizes from 3/16 through 1 1/8 in. OD.

FREE: "Tips on Stainless for Aircraft Hydraulics." Write Superior Tube Company, 2030 Germantown Ave., Norristown, Pa.

Superior Tube

The big name in small tubing

NORRISTOWN, PA.

All analyses .010 in. to ½ in. OD—certain analyses in light walls up to 2½ in. OD

West Coast: Pacific Tube Co., Los Angeles, Calif. • FIRST STEEL TUBE MILL IN THE WEST

1500–1600 Adjustable, 0.5–4000 psig, -2–200 psia
1580 gage–1880 absolute, Miniature (4 oz.), 2–3000 psi
1702 Altitude sensing, 500–50,000 feet
1590 gage, Subminiature (2½ oz.), 10–3000 psig

Need qualified Pressure Switches for Aircraft & Missiles?

HAYDON SWITCH will help solve your requirements with its proven line of miniature and subminiature, gage, absolute and barometric adjustable and non-adjustable Pressure Switches . . . qualified to MIL-E-5272. SPDT or DPDT circuitry with sealed or unsealed snap-action switches, and high-temperature versions available.

Write for your FREE Pressure Switch Bulletins today . . .

HAYDON Switch INCORPORATED

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PLaza 6-7441

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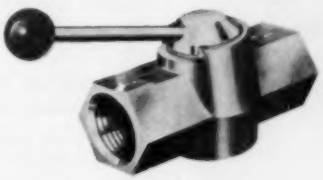
CIRCLE SEAL PLUG VALVE ... *LEAKPROOF IN HIGH VACUUM SERVICE*



9200 SERIES

Positive sealing in high vacuums to 150 psi. Sizes ⅛", ¼", ⅜", ½", ¾". Available in brass or 303 stainless.

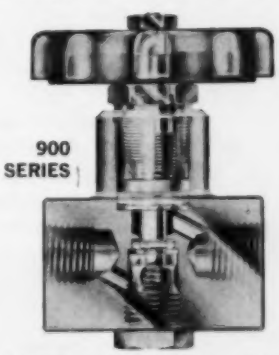
CIRCLE SEAL precision valves

Design of the Circle Seal 9200 Series Plug Valve features use of three O-rings. In closed position, O-ring on cylindrical face of plug prevents leakage past inlet port. In open position, the valve is fully ported and allows straight-thru flow passage. Stem leakage is entirely eliminated by static O-rings at top and bottom around circumference of plug. Effortless quarter turn from full open to full close. No springs used . . . no adjustments required.

CIRCLE SEAL precision valves

Military Service:
JAMES, POND & CLARK, INC.
Industrial Service:
CIRCLE SEAL PRODUCTS CO., INC.
2181 East Foothill Blvd., Pasadena, Calif.

CIRCLE SEAL *HIGH PRESSURE* SHUTOFF VALVE ... *LEAKPROOF Fingertip Operation*



0-6000 psi. ¼" pipe and ⅜" tube connections. 303 Stainless construction.

CIRCLE SEAL precision valves

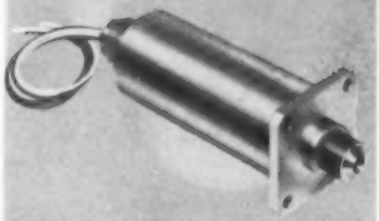
Unique design combines **positive** leakproof shutoff with full flow passages and freedom from wire drawing. Design of stem and seat permits simplified throttling of flow. Light fingertip operation actuates either a handwheel or toggle lever for rapid actuation. Unique and useful variations on the basic 900 Series configuration: • Right angle flow. • Integral Relief—combines relief valve function with shutoff permitting cylinder thermal pressure relief, etc. • Triport with one inlet and two outlets or one outlet and two inlets.

CIRCLE SEAL precision valves

Military Service:
JAMES, POND & CLARK, INC.
Industrial Service:
CIRCLE SEAL PRODUCTS CO., INC.
2181 East Foothill Blvd., Pasadena, Calif.

Circle **99** on Reader Service Card

CRYOGENIC SOLENOID SOLUTIONS



imc's family of cryogenic solenoids are designed for specialized applications at environmental temperatures down to —422°F. These units can be supplied as hermetically sealed and explosion proof packages and can also employ highly reliable latching mechanisms. Use of this unique latching mechanism permits intermittent duty operation under all temperature conditions with no power requirement for hold-in force. Intermittent duty operation makes possible unusually large amounts of force, when required. An open switch, which indicates position of the main plunger, can also be designed into these units. This switch is isolated, and operates in helium under pressure to eliminate the possibility of freezing.

All imc cryogenic solenoids utilize a specially designed coil and are engineered primarily for efficient and stable operation at ultra-low temperatures. Yet, these solenoids can be designed to operate over wide ambient temperature variations. For example: imc solenoids have been designed to perform efficiently at ambient temperatures from —422°F through +165°F.

SPECIFICATIONS OF A RECENTLY DEVELOPED CRYOGENIC SOLENOID

TYPE:	Two single coils
VOLTAGE RANGE:	18 to 30 VDC
CURRENT:	2.0 amps maximum @ 28 VDC @ 78°F 5.5 amps maximum @ 28 VDC @ —422°F
RATED FORCE:	Pull—4.5 pounds @ .100" stroke @ 24 VDC @ 78°F (Return Spring Load—2.5 pounds plus Bungee Spring Load of 2.0 pounds)
DUTY CYCLE:	Continuous
TEMP. RANGE:	—422°F to +160°F
WEIGHT:	Unit 1¼ pounds, Plungers & moving parts 3 ounces

For additional information on cryogenic or other type solenoid units contact your local imc representative or our application engineering department.

imc Magnetics Corp.

WESTERN DIVISION
Also known as P&P engineering co.
6058 Walker Avenue
Maywood, California
LUdlow 3-4785 •
TWX LA 1664-U

OTHER PRODUCTS: rotary solenoids/linear solenoids—ac or dc/synchros—sizes 8 & 11/resolvers—size 8 & 11/step-servo motors—size 5, 8, 11, 15, & 23 for digital-to-analog • analog-to-digital conversion/synchros, DC size 10/function generators/electro-mechanical assemblies.

Circle **95** on Reader Service Card

AEROSPACE NEWS

from the fluid power field

N. J. Mr. Waivers, a physicist, will direct the design and development of a line of physical simulators, transducers, and other environmental devices.

Hydrodyne develops bellows type bubble chamber

A hydrogen bubble chamber made entirely of beryllium copper with a precision machined bellows and arc welded lid and flange has been developed by Hydrodyne Corporation, Los Angeles. The chamber is for liquid hydrogen pumps

in nuclear, and cryogenic equipment. The bellows has a total deflection stroke of ⅝ in. and is designed to operate through a minimum of 1,000,000 strokes at 1 cps while operating at —420 F, the temperature of liquid hydrogen. Internal pressure is 0 psia (less than 5 microns), and external pressures are up to 150 psia.

Kearfott opens new Los Angeles plant

Kearfott Divison, General Precision, Inc., announces the opening of a new plant in Los Angeles.

This new western region office, 9000 sq. ft. in area, consolidates engineering, production, sales, and administration activities formerly conducted at Pasadena.

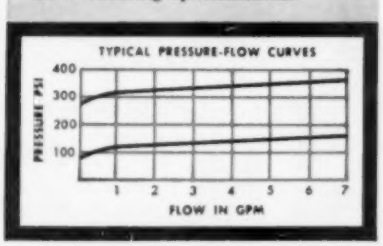
continued on page 149

For Precise Control of Pressurized Fluids . . .

Reliable Cartridge RELIEF VALVE

- Eliminates connectors, fittings and lines.
- Reduces leakage points.
- Simplifies maintenance.
- Reliable.
- Noiseless.

• Simplified circuitry, reduced weight and greater design freedom are other advantages offered by this direct acting relief valve. Used in a multi-stage manifold, this valve can be removed without disconnecting any lines. It is just one of many fluid flow and pressure control valves Fluid Regulators has designed and manufactured to meet exacting specifications.



SPECIFICATIONS:

- Operating Pressure: Three ranges 75 - 500 psi
- Burst Pressure: Above 5,000 psi
- Cracking Pressure: Externally adjustable
- Internal Leakage: Drops per minute
- External Leakage: Zero
- Fluids: All fluids compatible with stainless steel and anodized aluminum
- Temperatures: —65°F. to +275°F.
- Weight: 6 oz.
- Part No.: 7385

This valve can be furnished with a body and to meet user's pressure and flow requirements.

Write for detailed literature

Fluid Regulators CORPORATION

313 Gillette Street • Painesville, Ohio
ELmwood 2-3319

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Circle **129** on Reader Service Card

ON MARK COUPLINGS

NEW ON MARK QUICK DISCONNECT HYDRAULIC COUPLING...

Rated at 4000 P.S.I.

Designed for demanding hydraulic systems, On Mark's new 5-5012 series couplings meet and exceed Mil-C-25427 . . . with a rating of 4000 P.S.I. For applications where the severe impulse requirements of Mil-C-25427 are not required, this coupling may be used with operating pressures up to 6000 P.S.I. The unique locking device, an integral part of the coupling, gives a full 360° grip on the mating part for maximum locking power. It will withstand extremely high pressure and shock loads, yet can be coupled or uncoupled without special tools, with no leakage. Available now in sizes from ¼" up.

SPECIAL SAFETY FEATURE

Basic coupling can be fitted with indexed "keys," as illustrated, to prevent mismatching different fluid lines.

For full information please contact

ON MARK COUPLINGS, INC.

4440 York Boulevard, Los Angeles 41, California
Telephone CLinton 4-2501

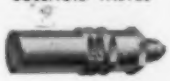
MC

missile-tested precision

IS ASSURED IN SUBSYSTEM DESIGN AND MANUFACTURE

COMPLEX PACKAGES

SOLENOID VALVES



RELIEF VALVES

ALSO Shuttle, Relief, Transfer, and Brake Valves; Compressors; Pressure Reducers.

Whatever your component requirements may be you will find our complete facilities are integrated for thoroughness and precision at every step—synchronized design, functional development and modern, efficient production, guaranteed by experienced testing. We invite your inquiry for a simple valve, a complex subsystem or anything new that demands imagination and experience.

WRITE, WIRE, or PHONE for data, quotations, and service

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NO OTHER PRESSURE GAUGE OFFERS SO MUCH

Rugged beyond all mil specs, these light weight Bourdon-Helix gauges maintain constant accuracy under the most severe environments.

Essentially custom-made to individual specifications, Bourdon-Helix designs have been successfully created for over 1800 special applications, any one of which may be a solution to your gauge problem.

Catalog available upon request

Glassco instrument company

777 South Arroyo Parkway Pasadena, Calif.

Circle **70** on Reader Service Card

New adjustable differential pressure switches

Actuation Range:
0.25" of water column
to 200 psi differential.
Working Pressure: to 5000 psi.

DELTADYNE

Patent No. 2,942,572

- **Accurate: reproducible within 1% of setting in many ranges**
- **Small: 3" x 2" (approx.)**
- **Light-weight: made of precision-machined aluminum and stainless steel (other materials available)**
- **Vibration-resistant: withstands frequencies up to 2000 cycles/second**
- **Leak-proof: no mechanical linkages; no moving seals**
- **Performance-proved: related units of this type in operation over 4 years in critical airborne and industrial installations**

See Deltadynes at Design Show Booth #960

This amazing switch, useful for pressure or differential pressure, combines advantages and economy not previously available in fluid system warning devices. Pressure may be adjusted in the field on a direct-reading dial. At set pressure, switch actuates to sound alarm, light bulb, turn motor on or off, or operate valve—in place or at remote panel board. Most models are not damaged by overpressures up to rated working pressure.

WRITE FOR LITERATURE

0.25" to 16" of water column, 250 psi working pressure—BULLETIN E7
0.125 to 16 psid actuation, 250 psi working pressure—BULLETIN E8
15 to 200 psid actuation, 5000 psi working pressure—BULLETIN E9

PALL

PALL CORPORATION • GLEN COVE, N. Y.

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Circle **159** on Reader Service Card

Accurate, Automatic temperature control

OF HYDRAULIC AND HEAT TRANSFER FLUIDS

Peak performance of hydraulic equipment is assured by the precise, dependable oil temperature control maintained by the Sterlco Temperature Control Valve, Series 150E. It's completely automatic, self-contained, compact and low cost . . . operates in any position. Write for details.

Sterlco®
Temperature Control Valve
Series 150E

Leaders in temperature controls since 1916

Sterling inc.

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Industrial Control Division

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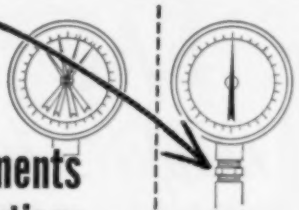

protect instruments from line pulsations and surges on refrigeration and automotive systems...

CHEMIQUIP'S NEW RS SNUBBERS

Designed for automotive, refrigeration or air conditioning applications, Chemiquip's newest snubber assures steady, accurate pressure readings . . . smooths out pressure impulses and fluctuations . . . protects pressure-sensitive instruments. Snubber element fabricated of Type 316 porous stainless steel membrane; unaffected by suspended oils in freon-type refrigerants . . . does not clog or plug.

Available in brass or steel in ⅛" and ¼" npt, male or female by ⅛", ¼", ⅜" and ½" flared and compression tubing.

Write TODAY for detailed bulletin BW-741

CHEMIQUIP CO. 36 East 10th St., New York 3
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Circle **43** on Reader Service Card

AEROSPACE NEWS

from the fluid power field

Cryogenic engineering appointments by Hydro-Aire

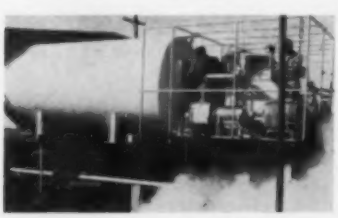
Richard Blythe and David Wilson have been named project manager and chief designer, respectively, for cryogenics by Hydro-Aire Company, Burbank, Calif. Both men have been closely associated with developments in the cryogenics field for the last ten years. At Hydro-Aire they are developing a new line of cryogenic control devices.

Whittaker Controls' new engineering assignments

As part of a reorganization program, Whittaker Controls Div. of Telecomputing Corp., Los Angeles, announced new assignments in its field engineering department. George F. Anisman, formerly director of field engineering, has been appointed to the new position of director of marketing. Frederick G. Space, Jr. formerly western field engineering manager will be in charge of Whittaker's field offices, local field engineers, and customer support department. Another newly created position, special product applications manager, goes to Alvin P. Cluster, previously eastern field engineering manager.

Cosmodyne opens test facilities

Cosmodyne Corporation of Hawthorne, Calif. is offering high-pressure, high flow gas testing as a service to testing companies and manufacturers. The test capabilities are flows to 120,000 scfh and



pressures to 15,000 psi. Other services available are LOX cleaning and packaging at the Hawthorne plant, field cleaning of tanks and process piping, and helium detection. ▼▼▼

AUTOCLAVE ENGINEERS ERIE, PA.

AIR-OPERATED VALVES

Your need for air-operated valves in systems with limited space is answered here. Light weight . . . easy to install, these new AE Air Operated Valves are far more compact than any such units thus far offered. They're designed for on-off use with 1/8, 1/4, 3/8 or 9/16 inch stainless steel tubing and for pressures up to 5,000 p. s. i. Your choice of either air-to-open or air-to-close designs.

Complete information is offered in Bulletin 361—yours for the asking.

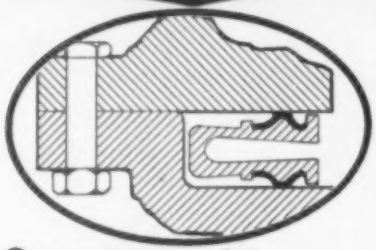
AUTOCLAVE ENGINEERS, INC.

2935 West 22nd Street • Erie, Pa.

Designers and Builders of High Pressure-High Temperature Equipment including: Valves • Fittings Stirred Autoclaves • Reactors • Pumps • Compressors • Complete High Pressure Package Systems including Instrumentation and Controls.

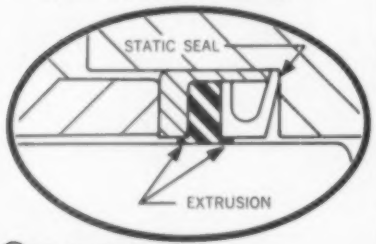
Circle 21 on Reader Service Card

FOR UNIQUE OR CRITICAL SEAL PROBLEMS



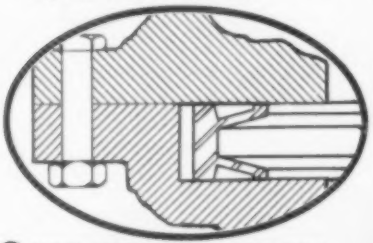
1 DEL PNEUFLEX STATIC SEALS

- Designed specifically to meet cryogenic applications of low and high pressure requirements in missiles and high performance aircraft.
- A flexible metallic ring with protruding Teflon sealing edges. Uses inherent spring property of the metal ring and the pressure being sealed to force a tight joint.
- Temperature range from —450°F to 500°F at pressures up to 5000 PSI. Re-usable. Requires only light flange loading.



2 DEL SHAFT SEALS

- For reciprocating or low speed rotary motion.
- Only spring-loaded Teflon seal using extrusion principle.
- Guarantees leak-proof fit, controls cold flow . . . is self-compensating for wear.
- Temperature range of —320°F to 500°F at pressures up to 10,000 PSI.



3 HASKEL METALLIC FACE STATIC SEALS

- Silverplated Inconel-X seals.
- Designed specifically for extreme temperature requirements of systems in missiles and high performance aircraft.
- Integral height control. Install by indexing seal to one mating surface and bringing opposite surface against seal.
- Temperature range from —450°F to 2000°F at pressures up to 20,000 PSI. Re-usable. Requires only light flange loading.

For complete information, contact

HASKEL SEALS A DIVISION OF

Haskel ENGINEERING & SUPPLY CO.

1236 So. Central Avenue, Glendale 4, California

Circle **82** on Reader Service Card

AEROSPACE COMPONENT DATA

Dual Actuator Test Stand

Features: Hydraulically operated precision test stand for load testing and calibrating linear and rotary actuators used on aircraft and missiles. For linear actuators the stand measures loads in tension or compression, readout of applied load, stroke length for electrical and mechanical stop adjustment, actuator end play, and jam tests. For rotary actuators, the stand measures torque loads, readout of applied load, rotation for stop adjustment, and actuator backlash. **Specifications:** Measures linearly to ±0.006"; rotary, ±10 min; and ±2% of force measurements.—*AiResearch Mfg. Div., The Garrett Corp., Los Angeles.*

Circle **500** on Reader Service Card

CHECK BM VALVES

Specify the very best !

ULTRA PRECISION #750 SERIES
Very low back pressure. Disc sealing on "O" ring seat—3,000 PSI service. 1 PSI crack pressure. Leakproof.
ONE PIECE NIPPLE #1500 SERIES
Disc sealing on "O" ring seat. Excellent flow. —2 PSI crack. ¼, ⅜, ½ MPT. Leakproof.
ONE PIECE BODY #900 SERIES
Disc type—"O" ring sealing. 2 - 6 PSI crack pressure. ¼, ⅜, ½ M.P.T. Also —4, —6, —8 AND 10050. High pressure — leakproof.

SPECIALS

CUSTOM DESIGNED AND BUILT CHECK VALVES FOR HUNDREDS OF INDUSTRIES—QUANTITY PERMITTING

BODNAR & McDERMOTT MFG. CO. INC.

23 BEECHWOOD AVE., MT. VERNON, N.Y.

Circle **31** on Reader Service Card

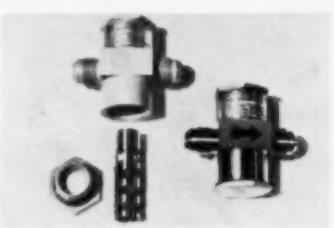
Ground Support and Test Equipment

Booklet covers hydraulic sensing, switching, measuring, and control devices, as specific components or complete systems for aircraft and missile support. Developed for extreme temperatures, pressures, and corrosives. Illustrates pneumatic servicing unit and hydraulic test stands to 5000 psi, 100 gpm. Shows valves to 3", 300 psi.—*Consolidated Diesel Electric Corp., Stamford, Conn.*

Circle **501** on Reader Service Card

Miniature Fluid Filter With By-pass

Features: By-pass ball valve in filter allows full flow in case filter clogs. Adjustable to open through a pressure drop range of 20 to 100 psi. For use with liquids and gases. Stainless steel mesh filter



element filters to 10 microns, is 1⅛ sq. in. in area. Element can be removed from either end of the body. In-line ports permit straight-through flow and small pressure drop. Weighs 2 oz.

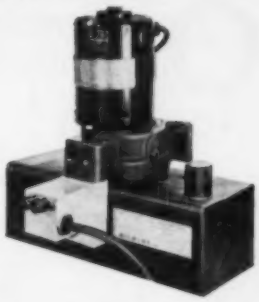
Designation: Model P/N 1850.—*Pyrodyne, Inc., Los Angeles.*

Circle **502** on Reader Service Card

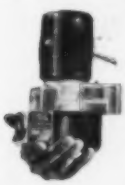
Continued on page 152

Circle **128** on Reader Service Card

A complete OIL-DYNE hydraulic unit could fit on this page — with room to spare!



If you still believe that hydraulic units must be big and bulky, you just haven't seen Oil-Dyne's miniature power package! And if you think the motor or pump must run constantly, you haven't heard that an Oil-Dyne motor and pump run ONLY while the cylinder piston is in motion. Perhaps, too, you didn't know that Oil-Dyne has eliminated all the complex external valving for directional control . . . and that when you shut off an Oil-Dyne reversible pump, the piston is automatically locked in position, and stays there indefinitely. Just to make sure you're aware of what's happened in hydraulics since Oil-Dyne pioneered miniaturization, you ought to write for our Catalog 21-E.



PIONEERING MINIATURIZED HYDRAULIC ACTUATION

OIL-DYNE INC.

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PUMPS • CYLINDERS • VALVES
PRESSURE SWITCHES • ACCESSORIES

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sure action

IN ALL ENVIRONMENTS

H11-2 hermetically-sealed SWITCH

CONFORMS TO MS-24331-1

Ideal for any exposed control or indicating application subject to severe environmental conditions. A rugged switch that mounts anywhere—through a single mounting hole. Infinitely adjustable by use of lock-nuts. Hermetically-sealed by backfilling with dry, inert gas, and tested to insure a leak rate of less than 1 micron cubic foot per hour. Meets all requirements of Immersion Test MIL-E-5272, Procedure 1. Functions perfectly in temperatures from −100° to +221° F.

HUNDREDS OF VARIATIONS OF THE H11-2 ARE AVAILABLE including models with high operating and overtravel forces for positive ice-breaking operation. Ask for HERMETICS CATALOG No. 130.

CONTROLS COMPANY OF AMERICA
CONTROL SWITCH DIVISION

4224 W. Lake St., Chicago 24, Ill. • VAn Buren 6-3100 • TWX CG-1400

Manufacturers of a full line of switches, controls and indicators for all military and commercial applications. All standard units stocked for immediate delivery by leading parts Distributors.

Circle **48** on Reader Service Card

Super Clean Center for

KOHLER PRECISION CONTROLS

Ultimate safeguard for reliable performance

Latest technological methods and surgical clean conditions for Kohler precision controls thoroughly eliminate contamination.

Hydraulic valves and other components are degreased and cleaned with ultrasonic facilities before assembly, testing, inspecting and packaging in the Super Clean Center. The air is filtered to 10 microns with temperature and humidity strictly controlled. Valves for missiles are heat sealed in individual airtight containers.

With full facilities in one plant, Kohler Co. manufactures valves and fittings for aircraft, automotive, industrial and missile applications. Write for catalog.

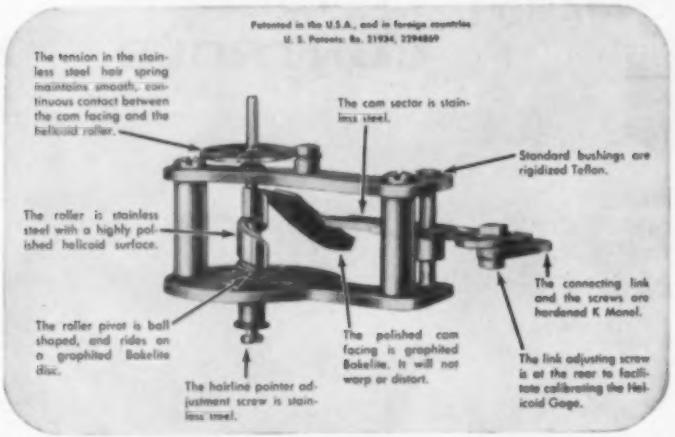
KOHLER CO. *Established 1873* KOHLER, WIS.

KOHLER OF KOHLER

ENAMELED IRON AND VITREOUS CHINA PLUMBING FIXTURES • ALL-BRASS FITTINGS • ELECTRIC PLANTS • AIR-COOLED ENGINES • PRECISION CONTROLS

Circle **105** on Reader Service Card

ACCO Helicoid Gage U.S.A.


Patented in the U.S.A., and in foreign countries
U. S. Patents: Re. 21934, 2294869
The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is stainless steel.
Standard bushings are rigidized Teflon.
The roller is stainless steel with a highly polished helicoid surface.
The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

Exclusive Helicoid movement provides... *Sustained Accuracy... on the toughest jobs*

• Helicoid Gages have no gears, no teeth, reducing wear to an absolute minimum. No danger of fouling, either—rolling action of cam facing keeps contact surface clean. Helicoid Gages have been tested through 75,000,000 cycles, with virtually no wear or loss of accuracy, while conventional geared gages became useless after 500,000 cycles.

Helicoid Gages give *sustained* accuracy even when subjected to violent pressure pulsations or mechanical vibrations. Pointer can be set externally, without removing glass, and cannot be jarred out of position. Dial faces are easy to read, won't corrode or chip. A full range of Helicoid Gages is available for any application. Next time, specify Helicoid—the gage that *stays* accurate.

Bourdon Tubes won't Stretch, Leak, or Crack

Helicoid Bourdon tubes are made from seamless tubing, and are designed for maximum torque and minimum stress. At the factory, each tube is individually tested, overpressured, and stress relieved. Four materials—alloy steel, K Monel, stainless steel, and phosphor bronze—are available to meet applications ranging from tap water to almost any acid.

NEW! Solid-Front Safety Case Gives Added Protection

The new Helicoid solid-front case diverts the force of a burst in a backward direction, away from the operator. The force escapes by deforming, though not detaching, the back cover plate. Helicoid Gages are also available in phenol, acaloy flanged, acaloy flangeless, polished flangeless, round flush, polished flush ring, and square flush cases.

WRITE for details **Ask for Catalog DH-65**

HELICOID GAGES

ACCO

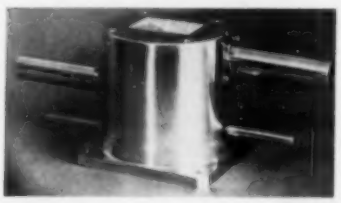
Helicoid Gage Division • American Chain & Cable Company, Inc.
929-H Connecticut Ave., Bridgeport 2, Conn.

Circle **85** on Reader Service Card

AEROSPACE COMPONENT DATA

Precision Pressure Regulator

Features: Regulate pressure from any remote point in the pumping system by connecting a tube from that point to the sampling port of the regulator. The regulator is self-correcting for effects of static pressure on the valving and also compensated for dynamic forces caused by gas flow. Can be operated above and below atmospheric pressure.



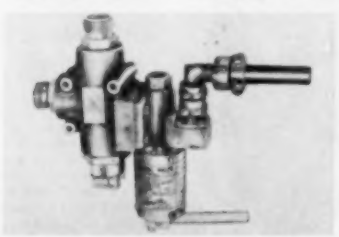
Specifications: Regulation typically ±0.1 mm Hg (0.002 psi) from minute flow to 30 cfm. Valve spindle, the only moving part, is mounted in Teflon.

Designation: Mark II, for regulation of a point upstream. Mark IIa, for a point downstream.—*Del Monte Technical Associates, Monterey, Calif.*

Circle **503** on Reader Service Card

Piloted Pneumatic Valve

Features: Piloted, high pressure valve designed for high impact shock, is 2-way, 2-position, magnetically operated. Supplied NC or NO, with manual override, visual



valve position indicator, and ⅛" or ¼" fittings. Missile/aircraft version has a forged aluminum body and operates on 18-30 vdc. Operating pressure is 3000 psig. Line and ambient temperatures are −65 F to 160 F.

Designation: Model MV-175.—*Marotta Valve Corp., Boonton, N. J.*

Circle **504** on Reader Service Card

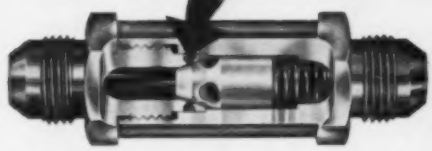
Continued on page 154

Circle **104** on Reader Service Card

Kep-O-seal®

RUGGED! DEPENDABLE! CHECK VALVES with the

Flexible Seal Seat*



- LEAK TIGHT! BUBBLE TIGHT!
- SURGE PROTECTED!
- FLOW—STRAIGHT THROUGH!
- LONG LIFE! EASY CLEANING!
- SIMPLE AND TROUBLE FREE!

The sturdy Kep-O-seal check valve can really take hard service. Conservatively rated, it absorbs severe shock from either direction and always holds its seal. *REMAINS LEAK TIGHT!* Has been proved outstanding in everything from machine tools to missiles! Investigate and see for yourself! Write for full details.

*Patent Applied For

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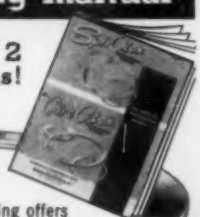
new edition / free retaining ring engineering manual

shows how Ramco's tOtal 2 solves your toughest problems!



SpirOlox

the unique 360° full circle ring offers many design variations.

SINGLE TURN RINGS • MULTI-TURN RINGS • SELF-LOCKING RINGS

It takes two types of rings to answer *all* retaining ring needs. That's why Ramco's tOtal 2—Spirolox and Circolox — provide the *superior solution* to your retaining ring problems. Your free Engineering Manual brings you the complete story — write for it now!

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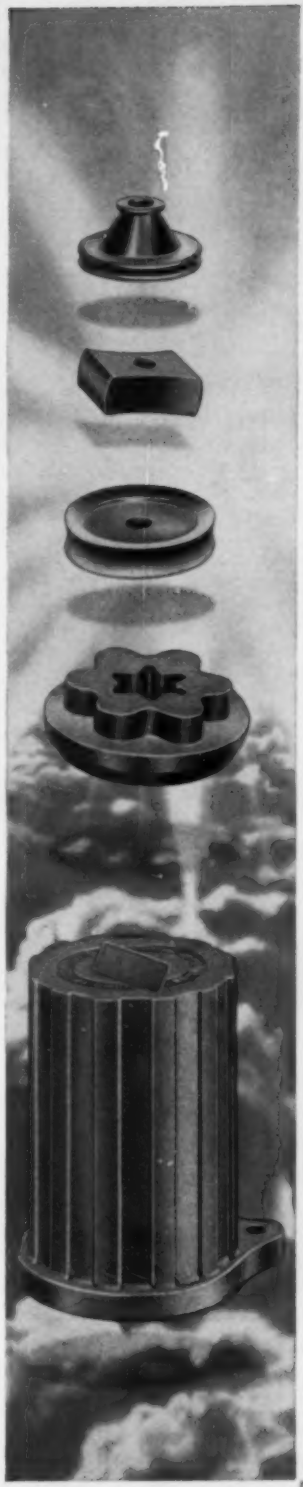

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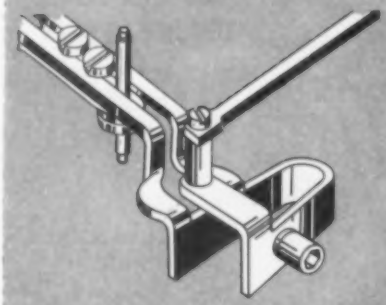
Circle **71** on Reader Service Card

HEISE GAUGES

MICRO-SLIDE



Highly favorable reaction among gauge users has followed the development of the Heise Micro-Slide adjustment. Systematic field recalibration of batteries of Heise gauges may now be directly and precisely effected with minimum time loss.

Calibration adjustments as fine as .0005 inches in the effective length of the sector slide may be quickly and conveniently applied.

Periodic recalibration of gauges may also be reduced as a result of the damping effect of the spring loaded adjustment which protects the setting from shock and vibration.

CONVENIENT PRECISION RECALIBRATION

The Micro-Slide comprises a spring loaded micrometer screw controlling the position of the link pivot. This screw may be conveniently adjusted with a standard Allen wrench. A flat spring cushions the assembly and protects the setting from shock or vibration.

Dial Sizes	FULL SCALE READING (P.S.I.)						
	0-15 to 0-5,000 inclusive	Over 0-5,000 and including 0-20,000	Over 0-20,000 and including 0-30,000	0 to 40,000	0 to 50,000	0 to 75,000	0 to 100,000
8½"	$183.50	$205.50	$238.50				
12"	$209.50	$231.50	$264.50	$275.50	$286.50	$336.50	$386.50
16"	$255.50	$277.50	$310.50	$321.50	$332.50	$382.50	$432.50

DELIVERY — 2 WEEKS FOR MOST RANGES — PRICE F.O.B. NEWTOWN

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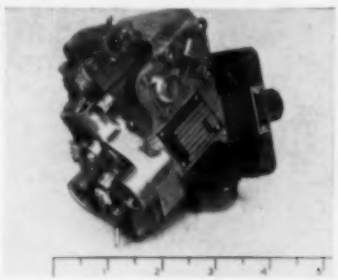
AEROSPACE COMPONENT DATA

Integrated Servo Motor Package

Features: Hydraulic motors, servovalve, and relief valves are integrated in one housing, for missile and aircraft control systems. The improved motor compared to a standard motor manifolded to a



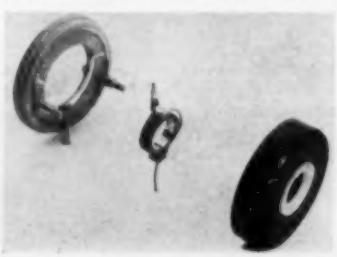
standard servovalve has ⅓ the breakaway torque and ⅓ the minimum smooth speed. Weight is reduced 20%; size, 30%. Motor uses high case pressure to reduce differential pressure required to start rotation. The reduced number of tube ports fittings, and bolted components increases reliability. No-load static hysteresis loop is unusually narrow and linear.

Specifications: Weighs 2.5 lb. Operates on standard aircraft hydraulic fluids, with supply pressures to 3000 psi, and signal input of ±8 ma. Operating temperature range is −65 F to 275 F. Size: about 3.5 x 4 x 3 inches.—*Aero Hydraulics Div., Vickers, Inc., Div. Sperry Rand Corp., Detroit.*

Circle **505** on Reader Service Card

Rotary Actuator Potentiometer for

Features: Potentiometer mounts directly on rotary actuator. Shaft of



actuator extends through the coil mounting sector, and the wiper ele-

Continued on page 156

Circle **182** →

FOR EXACTING SERVICE WHITEY*

CONTROL VALVES

for ⅛ through ½ O.D. Tubing feature usual and unusual metals with Swagelok Tube Fitting Connections

• MONEL • HASTELLOY B • INCONEL • BRASS • 316 S.S.

For years, WHITEY RESEARCH TOOL CO. has used exceptional machining and engineering skill to produce valves in new alloys that most manufacturers hesitate to machine. Monel, Hastelloy, Inconel and Nickel require top skill. It is through this manufacturing skill that quality performance is combined with quality appearance to provide precision, leak-tight WHITEY Valves to meet your most exacting system requirements.

WHITEY Valves are available in straight and angle pattern styles with ⅛" through ½" SWAGELOK Tube Fitting connections or ⅛" through ½" male and female pipe connections.

Panel mounting; Teflon* cylinder packing; micro-regulating and non-regulating stems are standard features on all WHITEY Valves. Colored handles, to permit color coding, can be specified when ordering.

Pressure ratings of WHITEY Valves range from 3,000 p.s.i. to 5,000 p.s.i. All WHITEY Valves are available with SWAGELOK Tube Fitting connections for efficient, leakproof installation.

COMPLETE TECHNICAL DATA ON *WHITEY* VALVES AVAILABLE ON REQUEST.

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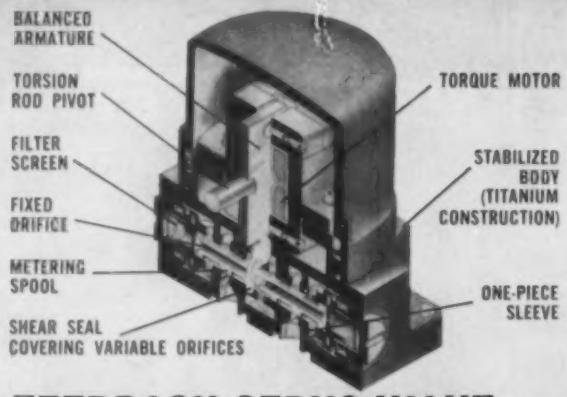
OAKLAND 8, CALIFORNIA

WHITEY* ™



A FEEDBACK SERVO VALVE WITHOUT SPRINGS OR LEVERS

- Unity coupled Hydromechanical Feedback
- High Null Accuracy
- Only 2 moving parts
- Large, full opening, shear-seal orifices

This two-stage, four-way flow control valve is the only one available that provides true positional feedback without springs or levers. The first stage consists of an electrical torque motor and "shear-seal" orifice hydraulic amplifier, while the second or control stage is made up of an accurately matched spool and sleeve arrangement.

Hydromechanical unity feedback relates spool position to torque motor armature position and also nulls out effects of orifice variations due to supply pressure and temperature fluctuations. Flow force reactions are thus substantially reduced and hydraulic centering of pilot position is feasible without spring hysteresis and null shift. Large orifices prevent clogging and silting and high shear forces permit efficient operation even with highly contaminated fluids. Final null adjustments are made electrically by a balancing control at amplifier output stage.

TYPICAL CHARACTERISTICS

	Medium flow (#6103-#6106)	High Flow (#6104)
Rated flow	to 7.5 gpm at 3000 psi valve pressure drop	to 18.0 gpm at 3000 psi valve pressure drop
Hysteresis	3% maximum total rated current	3% maximum total rated current
Supply pressure	300 to 3000 psi	300 to 4000 psi
Proof pressure	4500 psi pressure port 3000 psi return port	6000 psi pressure port 3000 psi return port
Pressure gain	First stage—500 psi per ma minimum with 3000 psi supply	First stage—500 psi per ma minimum with 3000 psi supply
Load pressure gain	8500 psi per ma minimum with 3000 psi supply	10,000 psi per ma minimum with 3000 psi supply
Temperature	—65°F to +275°F	—65°F to +275°F
Maximum Null Shift Temperature Change per 100°F	(% of rated current) 1%	1%
Supply Pressure Variation ±	2%	2%
Quiescent Current Change 20%	1%	1%
Weight	12 ounces	16 ounces

TORQUE MOTOR: Note: 6103 & 6106 identical with exception of torque motor characteristics.

	Valve #6103	Valve #6106
Input Power	300 Milliwatts	64 Milliwatts
Rated Current	± 10 ma	± 8 ma
DC Coil Resistance (other motors also available)	3000 ohms/coil	1000 ohms/coil

Write for complete data

KEARFOTT DIVISION
GENERAL PRECISION, INC.

Little Falls, New Jersey

Circle **101** on Reader Service Card

AEROSPACE COMPONENT DATA

ment is attached directly to the output shaft of the actuator. A cover with a Teflon dust seal encloses the coil and wiper assembly.—*Crescent Engineering and Research Co., El Monte, Calif.*

Circle **506** on Reader Service Card

Metering Cylinder

Has potentiometer pick-off. Measures volume deformation of pressure vessels by displacement of fluid enclosing the test specimen. Piston operates in vertical position with atmospheric pressure on top and fluid from test system on underside. Seals permit low friction and zero leakage across the piston. Piston weight overcomes residual friction effects.

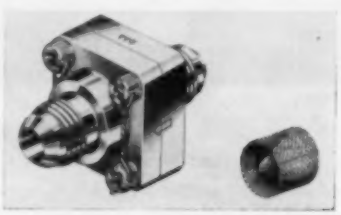
Specifications: Bore size 2.5". Stroke 3". Pick-off 5000 ohms. .25% linearity. .002" resolution. Pressure to 500 psig.

Designation: Model 404.—*Industrial Measurements Corp., Pomona, Calif.*

Circle **507** on Reader Service Card

Miniature Filter Assembly

Features: Small, compact assembly for in-line applications with corrosive liquids or gases in missiles and aircraft. Filter element is woven, wire mesh screen, a cylindrical



cup with a coned bottom. Filter is entirely of stainless steel except for an enclosed Teflon washer which seals the two halves of the body together.

Specifications: 1¼ in. square and about 2 in. long. Has been in service with gases to 2250 psi and will withstand temperatures from —350 F to 500 F. —*Dumont Engineering Corp., Long Beach, Calif.* ▼▼▼

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Gauges

The right gauge for your specific needs

A complete line of gauges in stock available for early delivery. Gauges from 10-inches water pressure to 30,000 P.S.I. to meet your specifications on any equipment.

- Pressure
- Vacuum
- Compound
- Altitude
- Combination
- Diaphragm
- Hydraulic
- Special Purpose
- Dial Thermometer (Vapor Tension or Bi-Metal)

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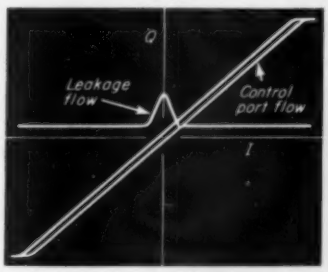
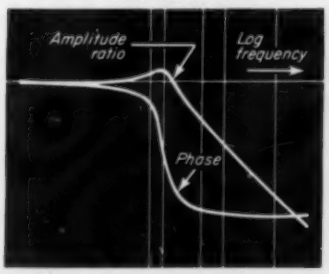
SERVOVALVE AND SERVO SYSTEM ANALYZERS

STATIC



Standard MODEL II-Series *VALVE FLOW ANALYZERS* automatically plot actuator port flow and internal leakage flow vs. current. ½ % accuracy over entire range. Features positive-displacement flow measurement. Modifications available for pressure and spool displacement plotting.

DYNAMIC



MODEL 100 *FREQUENCY RESPONSE ANALYZER* measures amplitude ratio and phase response of servo components and systems. Analog output facilitates automatic plotting of dynamic performance from ½ to 600 cps! Dynamic test actuators available for servovalve testing.

INDUSTRIAL MEASUREMENTS CORP.
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Foremost manufacturer of servovalve test equipment"
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Decco INDUSTRIAL SOLENOIDS give you dependability and top performance!

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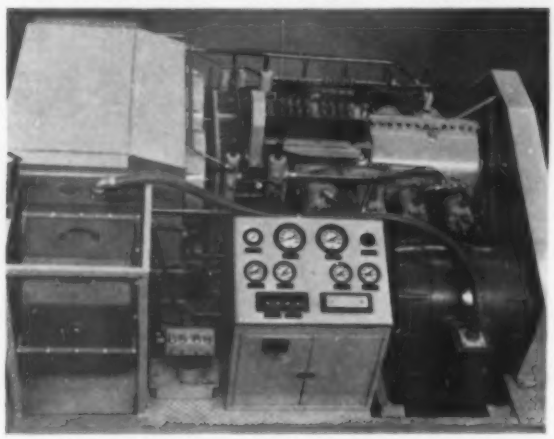
HIGH PRESSURE
HIGH CAPACITY, HIGH PURITY

AIR, HELIUM NITROGEN

FOR COMPONENTS TESTING OR PRODUCTION



MODEL DPB-CCS Four-stage, 8-cylinder compressor. System includes full dehydration and oil removal, filter and complete control panel. Backed by Cardair's 20 years of high pressure gas experience. The only ICBM type compressor qualified by 2500 hour life test.

CCC CARDAIR CENTRAL COMPRESSION SYSTEMS

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- up to 12,000 psi continuous
- with less than 1 ppm oil content
- 150 SCFM @ 128 psig intake • dewpoint −100°F.

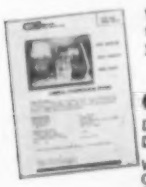
Developed and qualified as GSE equipment for ICBM program—now available from stock or programmed production!

Most recent broad purpose Central Compression System in the Cardair line, the Model DPB-CCS is a semi-portable, skid mounted unit, ready to install on location in less than a day. Only electrical and high and low pressure connections are needed.

In addition to air, helium and nitrogen, it can be easily adapted to other gases including hydrocarbons and hydrogen. Pressure range is from 3500 to 12,000 psi in continuous service and to 15,000 psi intermittently. Complete dehydration and oil removal equipment are included.

For either testing or production, it may also be used as a central high pressure source for diverse locations, with Cardair supplying the complete system.

Maintenance is simple and minimal, with nationwide Cardair service facilities. Installation is easy—no heavy concrete base is required.



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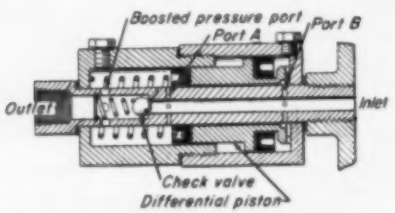
Circle **36** on Reader Service Card

FLUID POWER PATENTS

Hydraulic Pressure Booster

The booster was designed primarily for intensifying pressure in hydraulic brake circuits on mobile equipment. However, it can be used in any system where a booster is required.

• **Operation**—Fluid enters the booster through the inlet port on the right. It flows straight through, lifting the ball check valve off its seat. When pressure increases to a value determined by the piston spring force, fluid flow through port *B* forces the differential piston left covering port *A*. Fluid at the left of the differential piston flows through the boosted pressure port to the circuit being intensified. The ball check valve prevents reverse flow.



When inlet pressure is removed, the spring returns the differential piston. Fluid at the right of the differential piston returns to the system through port *B*. With the differential piston moved fully right, fluid from the intensified branch of the circuit returns through port *A*.

The degree of pressure intensification is in direct relation to the difference in area on the differential piston.

U. S. Patent No. 2,940,261 *by Gilbert E. Porter assignor of one half to Gunter Krause, Los Angeles, Calif.*

Pump Unloading Valve

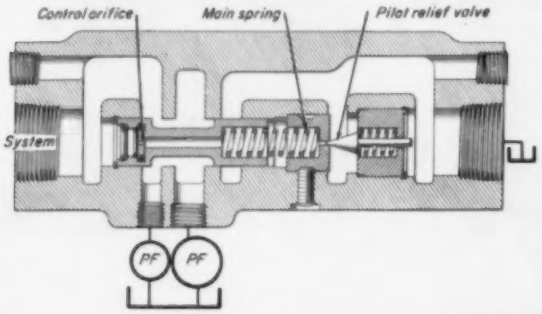
The valve connects the outlets of a large volume and small volume pump to a hydraulic system. It has a pilot valve which actuates the main valve to unload the large volume pump when system pressure is above a preset minimum.

• **Operation**—The small and large volume pumps connect to the valve's two inlet ports. The port on the left end of the valve connects to the fluid system and the port on the right end connects to tank.

With the valve in the position shown, the pilot relief valve is closed and both pumps deliver to the system. System pressure acts on both ends of the spool keep-

ing it hydraulically balanced. The spool is held open by the force of the main spring.

When system pressure increases to the setting of the pilot relief valve spring, the pilot relief valve opens. Fluid flows from the main spring chamber to tank. This flow causes a pressure drop across the control orifice which moves the spool right, compressing the main spring. The land at the left end of the spool closes off the passage in the valve connecting the



large volume pump with the system. The land at the right end of the spool opens a passage which unloads the large volume pump to the reservoir.

The small volume pump alone supplies fluid to the system until pressure drops below the setting of the pilot relief valve spring. The spool then shifts and both pumps again deliver to the system.

U. S. Patent No. 2,971,524 by Charles A. L. Ruhl, assigned to New York Air Brake Co., Kalamazoo, Mich.

Continued on page 163

HELE-SHAW® PUMPS NOW IN PRODUCTION IN A NEW, MODERN PLANT

The advanced engineering and production facilities of Aircraft Armaments, Inc. are now being applied to the manufacture of famous, precision-built Hele-Shaw and Hydramite Pumps. Write for full details on how these versatile pumps can help solve your power problems.

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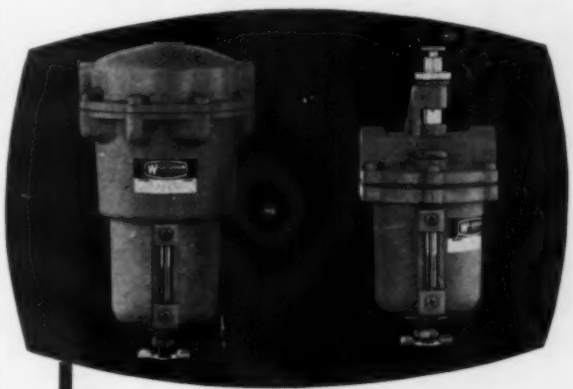
OBSOLETES

plastic bowls and bowl guards on air line products!



On filters and lubricators . . .

MAXIMUM VISIBILITY
of Water and Oil Levels

Exclusive design allows full 230° visibility and bowl can be rotated so gauge is in any position for easy, safe viewing. Thin metal bar in center protects heavy pyrex sight gauge from impact without interfering with visibility.

EXCLUSIVE!
REPLACEMENT SAVINGS!
WILKERSON SAF-T-BOWL is interchangeable with existing plastic bowl units.

EXCLUSIVE!
FURTHER SAVINGS!
Sight glass can be ordered separately and installed on existing metal bowl units.

EXCLUSIVE! ALL SIZES
Available on ¼" to 2" PT. Filters and Lubricators.

Eliminate the hazards of bursting bowls.
WRITE TODAY for complete information on the NEW Wilkerson SAF-T-BOWL contained in Circular No. 1041.

WILKERSON CORPORATION
Dedicated to keeping the NEW in pNEUmatics

1643 W. Mansfield
Englewood, Colo.

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NEWEST ADDITION TO THE WOOSTER FAMILY...

P-1 SERIES HYDRAULIC GEAR PUMPS

CAPACITIES:
0.4 TO 1.6 GPM AT 2000 RPM AND 2000 PSI
DISPLACEMENT:
.05 TO .20 CU. IN.
MAXIMUM SPEED:
4000 RPM

Pressure loaded* for higher efficiency, longer life—Optional side, rear or combination porting—Special alloy tin-aluminum bearings as used in heavy-duty industrial engines, all interchangeable—Double lip shaft seal—Hardened and ground steel gears and shafts—High quality, high tensile aluminum bodies and covers.

Consult our Engineering Department for application of these pumps at higher pressures.

*Patent Nos. 3480688, 3823615, 3824032

WOOSTER DIVISION B-W

BORG-WARNER CORPORATION
WOOSTER, OHIO

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Circle **74** on Reader Service Card

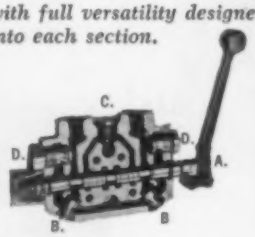
DESIGNERS:

"Here's everything you want in a multi-spool valve."

For heavy-duty mobile applications.

SECTIONAL CONSTRUCTION

with full versatility designed into each section.



A. Handle may be located at either end.
B. Anticavitation checks optional at one or both cylinder ports.
C. Load-checks in all sections.
D. Either ball-spring or pilot-type cylinder port relief optional in one or both ports.
E. Left end section includes inlet and outlet at either top or side option of ball-spring or pilot-type main relief.
F. Right end section options: Power-beyond, conversion plug, outlet or closed-center plug.
G. Individual sections may be replaced or added in the field.

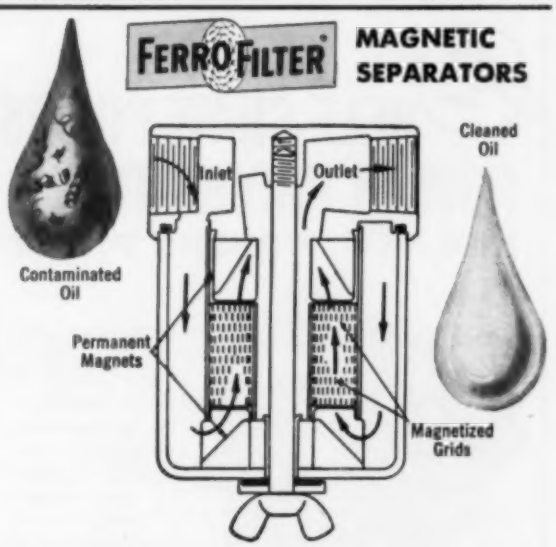
Now you can specify Gresen Directional Control Valves in banks of 2, 3, 4 . . . as many as eight sections, with any combination of features in each section. Take your choice of 3-way, 4-way, free-flow or 4-position float sections in any arrangement, then add the options shown at the left.

Available port sizes: ½", ¾", or 1" NPTF, or SAE Nos. 8, 10, 12, or 14 (outlet ports to SAE No. 16). Maximum pressure: 2500 psi. Capacity: 35 gpm. Ask about models 25P and 25PK.

GRESEN
MANUFACTURING CO.
405 - 35th AVENUE N.E., MINNEAPOLIS 8, MINN.

FOR PEAK PERFORMANCE OF HYDRAULIC SYSTEMS— INCLUDE THIS DEFENCE AGAINST FERROUS PARTICLES

FERROFILTER® MAGNETIC SEPARATORS



Frantz FERROFILTERS protect fluid power systems by magnetically removing microscopic ferrous particles which may pass freely through edge-type strainers and even escape cartridge-type filters. High pressure models for industrial applications up to 5000 psi; aircraft type to 3000 psi; low pressure models, 100 psi.

Ask for Bulletin and Specification Sheets with Prices.

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655 Kline Ave. at Brunswick Pike **Trenton 6, N. J.**

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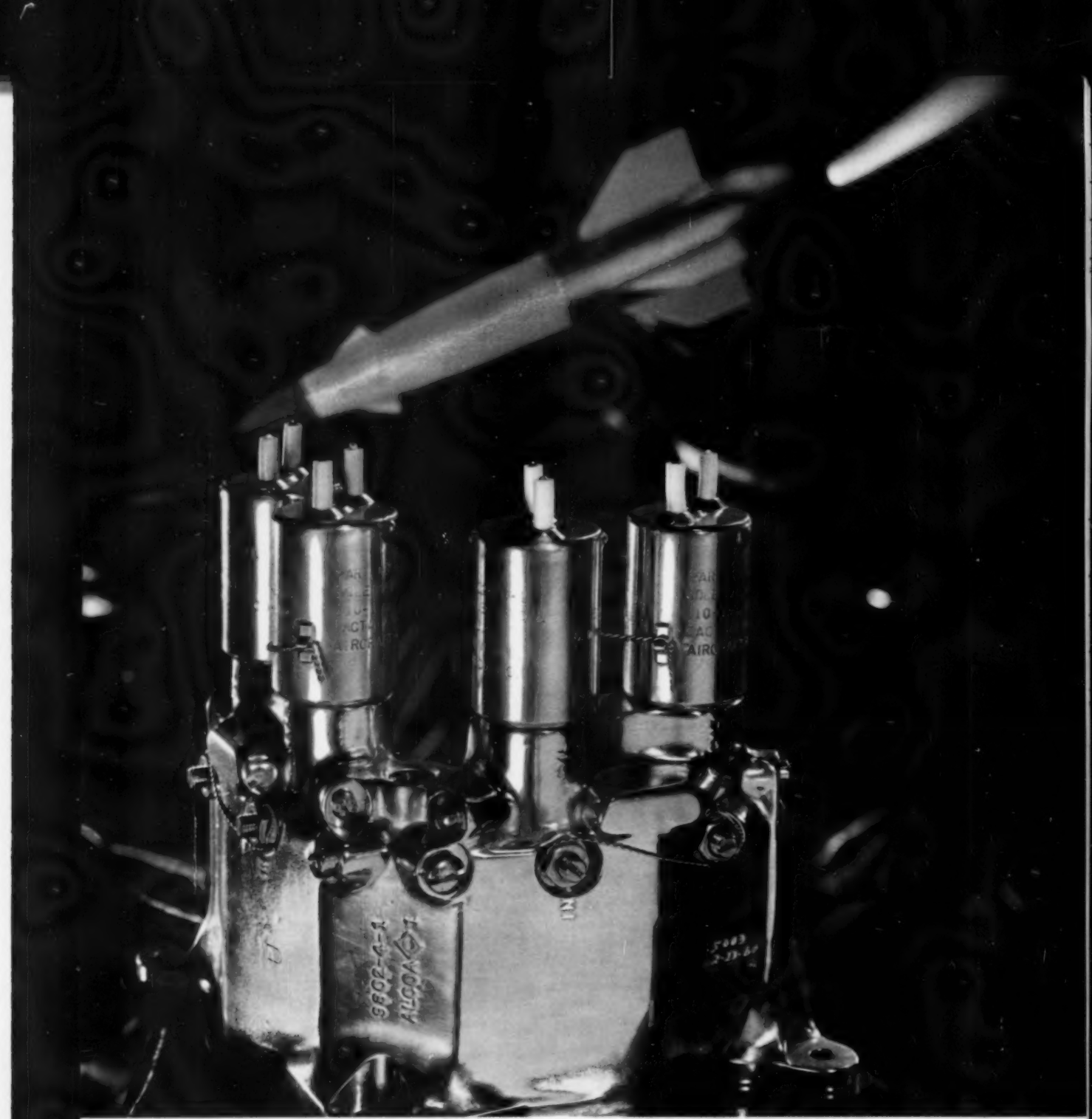
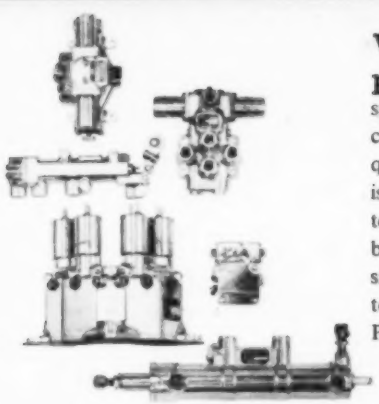
Circle 8 →





Where on earth . . . or in outer space . . . do you need the precision of Tactair valves? Like you, our interest is focused on missiles, space vehicles and GSE. As perfectionists, we seek to design the finest hydraulic or pneumatic components available anywhere. What is more, we are able to reproduce precision in any quantity. Possibly your particular valve problem can be solved with a modification of an existing Tactair design. Perhaps it calls for new development. Either way, we would like to talk to you about it and we make two promises. One, each job we do is done on a personalized basis: engineers working with engineers. Two, every job is backed by our warranty of responsibility. Both have been Tactair policy for 20 years. We can start with your valve problem tomorrow, if you will tell us what you are looking for today. Tactair Valve Division, Aircraft Products Company, Bridgeport, Pa. BRoadway 5-1000.

CONTROL, SELECT, BRAKE, RESTRICT, CHECK . . . with

TACTAIR®
AIRCRAFT PRODUCTS CO.

IPC adds service time to your end product with "RULON"...*

the tested... filled fluorocarbon material for packings and oil seals

IPC now incorporates "RULON"* . . . a *filled fluorocarbon plastic material* . . . in packings, oil seals or precision molded products to answer your most critical sealing problems.

This new combination . . . "custom" molded and bonded for your specific application offers many advantages: Superior abrasion resistance, lower friction, improved sealing, less torque and reduced shaft wear.

Special molding and bonding techniques, developed by IPC for "RULON"* insure long wear and excellent performance. For your critical applications investigate the extras of IPC's latest "custom" approach! You'll find more benefits in handling increased pressures . . . higher shaft speeds . . . and temperature problems too!

**Trade Name of Dixon Corporation.*

IPC

OIL SEALS / PACKINGS / PRECISION MOLDING *Custom designed for your application.*

INTERNATIONAL PACKINGS CORPORATION

Bristol, New Hampshire

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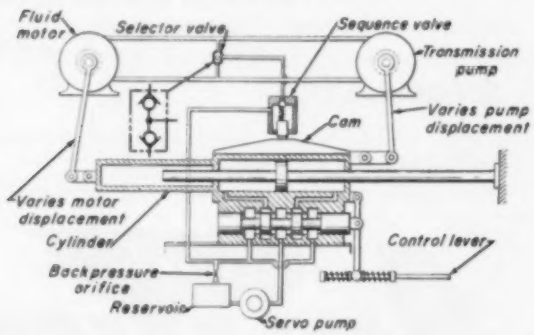
P-2

Torque Control for Hydrostatic Transmission

This invention provides a system in which torque exerted by the motor at any speed can be limited to a set value without wasting power.

It controls fluid motor torque in either direction while the motor is being driven, or in the case of mobile equipment, while the brakes are being applied.

• **Operation**—Levers controlling pump and motor displacement connect to the body of a double-rod-end cylinder. The piston rod is fixed and the cylinder moves. Flow to the cylinder is controlled by a mechanical servovalve. A small pump delivers fluid to the servo circuit. The lever positioning the servovalve spool connects to the engine throttle. This fixes the spool's position for a given speed, and through a linkage, maintains a set displacement for the fluid motor and transmission pump.



A selector valve takes fluid from whichever pump line is under pressure and directs it to a sequence valve. When pressure reaches the setting of the sequence valve, fluid flows into the servovalve's discharge line. A backpressure orifice restricts this fluid from returning to the tank. This backpressure of the servovalve discharge reduces flow through the valve. If pressure increases above the discharge pressure of the servo pump, flow through the servovalve reverses and the cylinder reduces pump displacement and increases fluid motor displacement.

The sequence valve's opening pressure is varied by a cam which increases or decreases the valve's spring force. The cam gives maximum spring force at zero pump displacement and minimum force at full displacement.

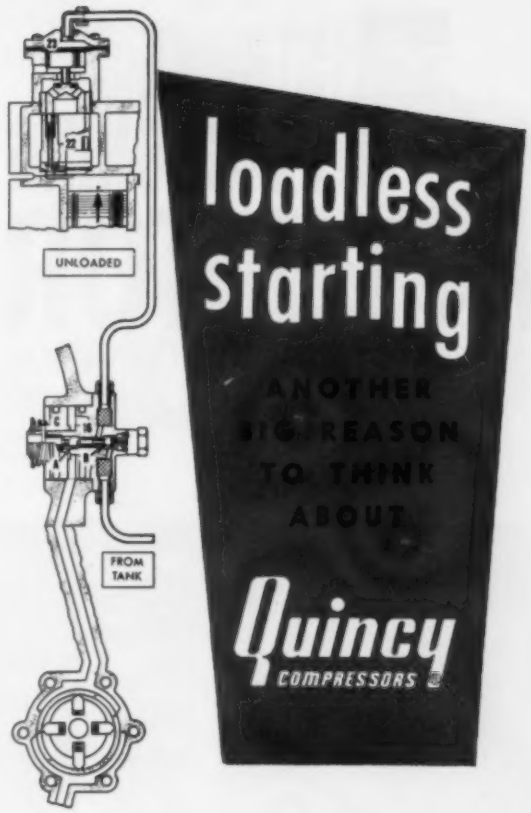
U. S. Patent No. 2,946,193 *by George E. Chittenden, assigned to The Keelavite Co., Ltd., Coventry, England.*

Other Patents Issued

HYDRAULIC VALVE

No. 2,973,013 *by Samuel A. Myers, assigned to Northrop Corp., Hawthorne, Calif.*

Continued on next page



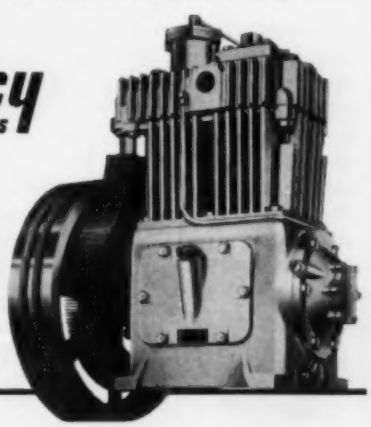
LOADLESS STARTING is an exclusive, patented QUINCY feature that eliminates a compressor starting load at all times. Loadless starting also puts an end to noisy and troublesome check valves. This outstanding design feature is recommended for automatic start and stop units.

Other QUINCY features that add up to constant efficiency and long life are Safe-Q-Lube pressure lubrication, Lynite connecting rods, perfectly balanced crankshaft, automotive type pistons, cushioned steel valves and large oversize Timken tapered bearings.

In all ways — from installation to years of reliable service — investment in a QUINCY repays itself best.

Quincy COMPRESSORS

CHECK THE 1960 "Q-LINE" NOW — a complete range of compressor models for all types of industrial applications.



QUINCY COMPRESSOR CO., Quincy, Illinois

Makers of the World's Finest Air Compressors

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STROKE POSITIONING ACTUATOR

FOR THE PRECISE CONTROL OF YOUR VARIABLE SPEED DRIVES • CONTROL VALVES • RHEOSTATS & PUMPS!

• furnishes strokes from ½ to 6 inches for forces up to 2510 lbs. of thrust.
• positional accuracy within 0.001 inch of stroke.
• compact, rugged, tamper-proof.
• operates from standard 3-15 psi instrument signal.
MODEL 600 SERIES ACTUATOR

Adaptability, speed, precise positioning and *power* are features of Annin's 600 Series actuators, designed for easy mounting on your existing equipment. Compact and rugged, these units may be operated from a standard 3-15 psi instrument signal, with a positional accuracy within 0.001 inch per inch of stroke. Supply pressures as high as 100 psig of air or gas can be used as the actuating medium. The compact, tamper-proof construction practically eliminates maintenance. Given a clean dry supply medium, long periods of trouble-free operation can be expected.

SEND FOR COMPLETE DETAILS
Ask for Actuator Bulletin 1236 s.t. containing complete technical information on Series 600 and other Annin actuators.

THE ANNIN COMPANY

DEPT. H • 1040 South Vail Avenue • Montebello, Calif.

Circle **19** on Reader Service Card

FLUID POWER PATENTS

HYDRAULIC ROTARY SELECTOR VALVE

No. 2,972,357 by Ralph Ford and Calvin Gladoske, assigned to Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.

MAGNETIC ACTUATOR

No. 2,972,467 by Wilbert M. Gilman, assigned to Rivett Lathe & Grinder, Inc., Brighton, Mass.

HYDRAULIC REVERSING CONTROL

No. 2,970,579 by Thomas H. Paris, assigned to Tomlon Corp., Trenton, N. J.

FLUID MOTOR

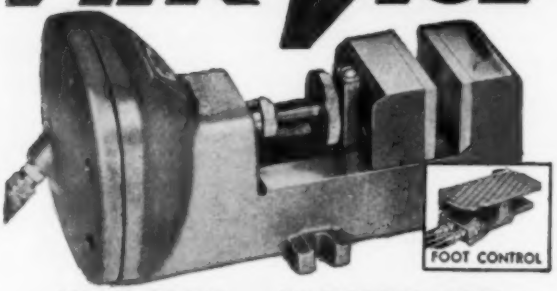
No. 2,970,578 by Teizo Kohatki, 3028-2 Shimokanuki Ushibuse, Numazu, Japan

SURGE VALVE

No. 2,973,012 by Adolf R. Grad, assigned to The Oilgear Co., Milwaukee, Wis.

▼▼▼

Speedy AIR VISE



HIGH SPEED • POWERFUL GRIP

New, improved model speeds up all repeat operations—*milling, drilling, tapping, punching, bending, riveting.* Both hands left free to produce more! Light squeeze to 2250 pounds pressure! Extra thick jaws for attaching jigs. Jaws open to 3-inches; 1/16" to 5/8" maximum travel. Complete with foot control, air hose and fittings..... $44.00

SPEEDY AIR REGULATOR
Regulates pressures 0 to 140 lbs. No. 422 $7.25

SPEEDY AIR FILTER
Assures clean, oil-free air. No. 140 $4.00
Slightly Higher West Coast

SPEEDY UNIT
Production spray unit with Ext. Mix Gun. No. 705 $26.50

Order from Your Supplier or Write for Air Tool Catalog

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AIR TOOLS • AIR VISES • AIR REGULATORS • FILTERS • COMPRESSORS

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Money Isn't Everything

But it's a big part of what you can get by entering the 1961 Fluid Power Prize Paper Contest. Cash awards total $1400. Along with the money, you get recognition for yourself and your company—awards are presented at the National Conference on Industrial Hydraulics in October. Papers are published in Hydraulics & Pneumatics.

You can submit a paper dealing with any phase of product or equipment development, new applications, circuit and component design, or fundamentals.

This is a contest of ideas, not writing ability. Use photographs, drawings, tables, or graphs to help your presentation.

Circle Reader Service No. 220 for details

H·I·S

PRECISION TEFLON* "U" Cups FOR

LOW FRICTION----- ---HIGH TEMPERATURE in any hydraulic fluid

Style 4505 "U" cups are accurately machined of virgin TEFLON to a special design developed by HALOGEN. 246 standard sizes are available without tooling charges.

Also available:

HALOGEN "V" RINGS

two types available for packed cylinders and other applications.

Write for literature . . . our new 12 page brochure on "U" cups is yours for the asking.

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NOPAK OFFERS YOU COMPLETE AIR CIRCUITRY

another Plus Value by NOPAK

NOPAK "V"

NOPAXAM

NOPAK-MATIC

The addition of Nopaxam palm button, cam, lever and air operated valves "closes the Nopak circuit." Precise control — mechanically or electrically signaled — can now be *completely* Nopak. Singularly or in combination, Nopaxam, Nopak "V" valves and Nopak-matic valves will meet your most complex circuit requirements.

Nopak "V," 4-Way, Pilot Operated Slide Valves

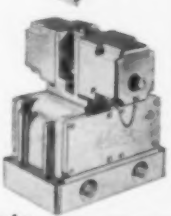
For direct or remote control. Either single or double air pilot or solenoid actuated. Simple, proven design, durable construction insure trouble free operation. See Catalog 102-A.

Nopaxam Precision Spool Valves

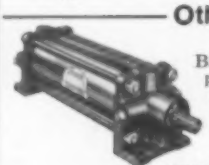
For air or hydraulic service to 150 psi. Pilot or mechanically operated, these valves are small, compact, easily mounted, have extremely short throw and high flow rates. See Catalog N.

NOPAK-MATIC Poppet-Type, Pilot Operated Valves

Fast acting, high volume air valves from ¼" to 1¼" with master (air piloted), single or double solenoid. Side or bottom ported subplates or manifolds. Removing cover plates affords easy access to piston poppets housed within removable, interchangeable cartridges. 100% J.I.C. See Catalog 105.



Other NOPAK "CVA*" Products

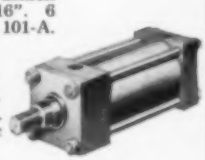


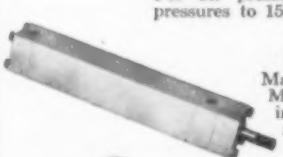
NOPAK Class 1 Cylinders

Brass Tubing and Tie-Rod Construction. For pressures to 250 psi. Choice of adjustable cushion, self-regulating or non-cushion heads. Diameters from 1½" to 16". 6 Standard Mountings. See Catalog 101-A.

NOPAK Class 6 Bore-Rated Cylinders

Compact steel plate, square head with tie-rod and honed steel tubing construction. For air pressures to 250 psi. hydraulic pressures to 1500 psi. See Catalog 106.





NOPAK Class 7, Square Barrel Cylinders

Made with pressure-cast and extruded aluminum. Mounting holes can be drilled or tapped directly into cylinder tubing. ¾" to 3" bores pressure rated for 200 psi. air or 1000 psi. oil. 7 universal mountings. See Catalog 107.

*CVA Cylinders, Valves, Accessories
NOPAK offers a complete line of Matched Fluid Power Components.

NOPAK
VALVES & CYLINDERS

NOPAK DIVISION
Galland-Henning Mfg. Co.
2743 S. 31st St., Milwaukee 46, Wis.

Circle **67** on Reader Service Card

NEW PRODUCTS

Continued from page 84

STAINLESS PIPE

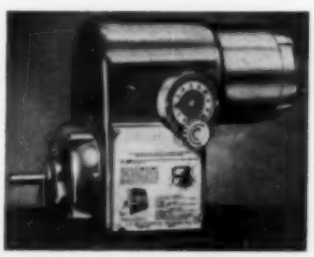
As-welded, unannealed stainless steel. For use where non-contamination of product is important.

Specifications: ASTM spec A-312. Schedule 5, 10, and 40 pipe sizes. **Designation:** 304L and 316L.— *Standard Tube Co., Detroit.*

Circle **313** on Reader Service Card

VARIABLE SPEED DRIVES

Hand control assembly. Positive anti-creep device prevents speed drift. Drive acts as speed changer, cone pulley, or controller and gear box.



Specifications: Speed ratios to 10:1. From 4 to 10,000 rpm. In ¼, ⅓, ½, ¾, and 1 hp. 3 phase and single phase. 60 cycle. **Designation:** 5 VA Varidrive.— *U. S. Electrical Motors Inc., Los Angeles.*

Circle **314** on Reader Service Card

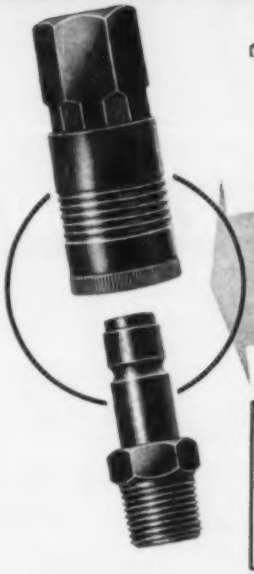
AIR PRESSURE REGULATORS

Provides remote regulation of inaccessible air lines. Column of controlled pressure air replaces adjusting screw and control spring used in standard units. When controlled line is out of reach, any size regulator with desired pressure range may be used as pilot regulator and

Continued on page 168

Circle **171** on Reader Service Card

TRU-FLATE



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QUICK DETACHABLE

couplers AND nipples

Quick couplers for air, steam, oil, gas, water, oxygen, etc. A broad range available of types and sizes....

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STANDARDS for INDUSTRY

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MODEL 8575 for Petroleum Base Fluids

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LARGE FACE—7" overall for excellent visibility

LEAK-PROOF—No Dripping

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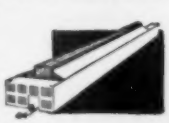

DESIGNERS & BUILDERS OF HYDRAULIC POWER UNITS PNEUMATICS, RESERVOIRS, HYDRAULIC ACCESSORIES & TEST STANDS

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fabric impregnated V-RING sets

"U" PACKINGS

CUP PACKINGS

HOMOGENEOUS CUP PACKINGS

FLANGE PACKINGS

DOUBLE LIP WIPERS

PHENOLIC ADAPTORS

V-RING SETS

HOMOGENEOUS "U" PACKINGS

"O" RINGS

...IN ELASTOMERS TO SUIT THE APPLICATION....

Periflex has assumed a leading position in packing design and development. Latest contribution to better reciprocating sealing techniques: Famous Periflex lip-action V-ring sets are now made available

Left—Periflex pressure rings preload the packing. Give lip-action that seals at all pressures with minimum interference. Right—Extrusion-proof "phenol-fab" adaptors. Reduce cavity machining costs.

in a variety of elastomers, assuring best performance for a wide range of hydraulic media. Write for reprint of the informative article from Hydraulics & Pneumatics magazine, "Elastomers For Hydraulic Packings", written by our Technical Director.

Periflex • Inc.

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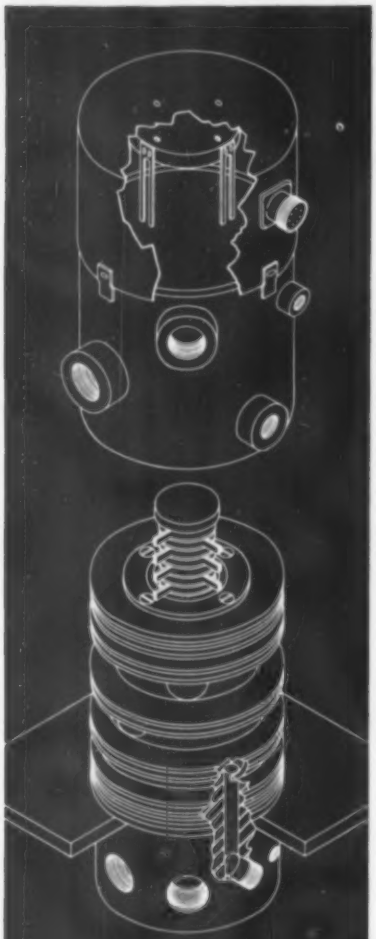
IMAGINATION FOR SALE!



CIRCLE OF POWER

UH-designed swivel assures a "circle of power" for an aerial lift by carrying two high pressure hydraulic lines, tank line, air line, and seven electrical lines from base to rotating superstructure. Operator in aerial bucket has complete freedom and flexibility of movement, can rotate 360° continuously. Some machines have only limited rotation in either direction. Whether your hydraulic problem is complex or commonplace...call or write UH today.

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DIVISION OF HOLAN CORPORATION
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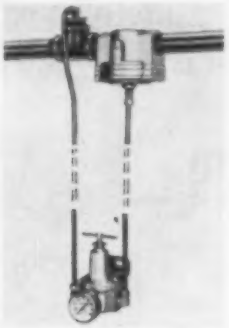
WILLOUGHBY, OHIO
PHONE: 946-2100

Circle **173** on Reader Service Card

NEW PRODUCTS

mounted conveniently. Has high flow poppet valve which opens to

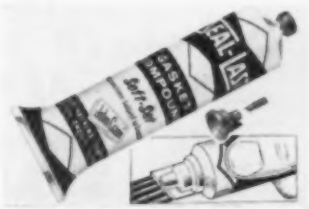


full pipe capacity in a very short stroke.—*Hannifin Co., div. Parker-Hannifin Corp., Des Plaines, Ill.*

Circle **315** on Reader Service Card

GASKET COMPOUND

Available in two types: soft-set for temporary connections; hard-set for permanent.



Specifications: Temperature range from −65 to 400 F. Pressures to 5000 psi. Comes in 1⅛ oz., 3 oz., and 11 oz. tubes.
Designation: Seal-Last.—*Crane Packing Co., Chicago.*

Circle **316** on Reader Service Card

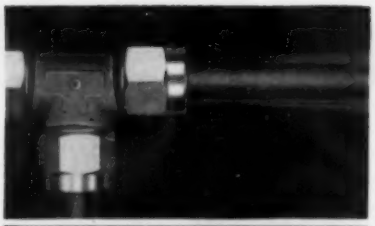
AUTOMOTIVE POWER UNIT

Direct, belt, or special drives. Any mounting position. Continuous or intermittent motors.

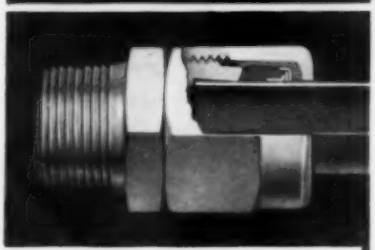
Specifications: 4¾" reservoir, lengths 6", 9", and 12". For 1¼, 2½, or 3 quarts. 6¾" dia reservoir for volumes over 2 gallons. Capacities ¼ to 4 gpm, 1800 rpm. Increased delivery at 3600 rpm. Pressures to 2000 psi.—*John S. Barnes Corp., Rockford, Ill.*

Circle **317** on Reader Service Card

Continued on page 170



Clear up your
VIBRATION
PICTURE
WITH
CHICAGO FORGING'S
NEW
Rubbernek
FITTING



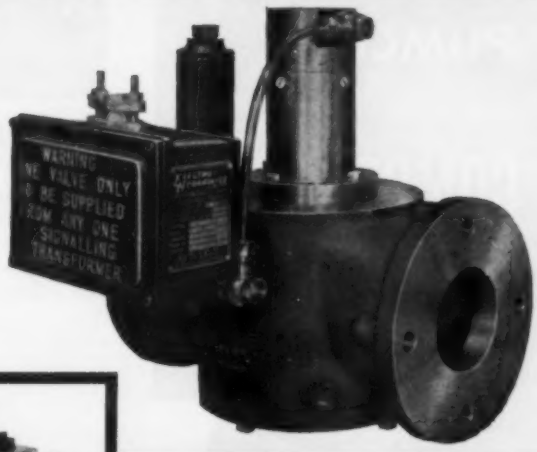
Rubbernek's patented cushion unit is especially designed to absorb impulse shocks, pressure surges and vibrations. Factory assembled, Rubbernek gives foolproof, time-saving installations every time. Insures a positive seal for pressure or vacuum; eliminates torque problems. Rubbernek offers many advantages for pneumatic, hydraulic and other fluid transmission systems. On every count — Rubbernek is the simplest, most easy-to-apply fitting for those who demand top performance plus economy. Our engineers will help you test-run Rubbernek in your own plant.

Write for Free
NEW RUBBERNEK
Catalog No. 161
Dept. PH

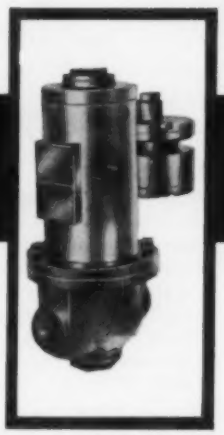
Some choice territories open for representation.

CHICAGO FORGING
& MANUFACTURING CO.
2004 SOUTHPORT AVENUE
CHICAGO 14, ILLINOIS

Circle **187** on Reader Service Card



For the positive control of all types of liquid or gases, a wide range of valves has been developed to meet the many industrial applications, e.g. test rigs, flow control, materials handling, interrupter gear. The range includes rectifiers and valves for working pressures up to 6,000 p.s.i. Many of these components are covered by Buxton Flameproof certificates. Valves can be supplied to meet any special applications. We invite you to discuss your project with us.



FLAMEPROOF VALVES

FOR INDUSTRY

ELECTRO-HYDRAULICS LIMITED
INDUSTRIAL SALES DEPARTMENT
WARRINGTON · ENGLAND
MEMBER OF THE OWEN ORGANISATION

EH LIMITED

ROD END INTERNAL THREAD TYPE "DREF" SERIES

"Dyflon"®

Self-Aligning and Self-Lubricating SPHERICAL BEARINGS

ROD END EXTERNAL THREAD TYPE "DREM" SERIES

Combine "Monoball"® Engineering Advantages with Life-Time Lubrication

Design engineers in many industries are specifying new "DYFLON"® SELF-ALIGNING and SELF-LUBRICATING SPHERICAL BEARINGS for these 5 major reasons:

1. **LOWER COEFFICIENT OF FRICTION**
...ideal where lubrication is impossible or undesirable.
2. **WITHSTAND EXTREME VIBRATION**
...perfect performance under shock load conditions.
3. **WILL NOT "COLD-FLOW"**
...even under extreme load conditions.
4. **IMPERVIOUS TO KNOWN CHEMICAL SOLVENTS**
...eliminates corrosion problems.
5. **FAIL-SAFE** ...due to "Monoball"® design.

Request Engineering manual No. 551.

In addition, due to their two-piece "MONOBALL"® design and plastic alloy insert, "DYFLON"® bearings have a long cycle life. Alignment and installation problems are minimized. Oil-free for life means lowest possible maintenance costs.

Available in a variety of plain or rod end types. Bore sizes to 3.000". Materials include stainless steel, plastic alloys and chrome alloy steels. Ultimate static loads to 500,000 lbs.

SOUTHWEST PRODUCTS CO. 1705 SO. MOUNTAIN AVE. MONROVIA, CALIF. · PHONE: MURRAY 1-9616

DARCOVA PUMCUPS

now available with

100% NYLON COMPOSITION

for HYDRAULIC CONTROLS, AIR CYLINDERS, RECIPROCATING PUMPS

Darcova Pumcup

Darcova 45° Bevel Type Pumcup

DARLING Pumcups—long noted for unequalled efficiency and life in all kinds of cylinders—are now greatly exceeding their own performance records! The new 100% Nylon Composition, available *only* in Darcova Pumcups, does it!

Nylon Pumcups are made in sizes, types and textures exactly right for your particular equipment—ready *now* to give you unprecedented piston packing performance!

Write for helpful data Bulletin No. 5903.

DARLING VALVE & MANUFACTURING CO.

Williamsport 15, Pa.

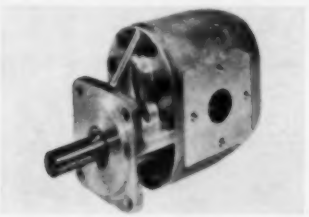
DARCOVA TRADE MARK PUMCUPS

Circle **52** on Reader Service Card

NEW PRODUCTS

PRESSURE-BALANCED GEAR PUMPS

Design employs discharge pressure to maintain an optimum counterbalanced thrust of the journal bearings toward the gear faces to control leakage and wear. Envelopes,



flanges, porting, and shafts based on SAE standards.

Specifications: Speeds to 2800 rpm. Flow rates to 60 gpm. Pressures to 2250 psi. Temperatures 250 F. Oil viscosity 55 SSU.

Designation: GPA3 series.—*Berry Hydraulics, Div. Oliver Tyrone Corp., Memphis, Tenn.*

Circle **318** on Reader Service Card

BALL VALVE

Molded of unplasticised polyvinyl chloride. Permits full flow with no pressure drop. Maintains high dimensional stability. Teflon seats

and Neoprene O-rings. Cleaning and maintenance can be handled without removing from line.

Specifications: Size to 3". Pressures to 125 psi with ¼ handle turn. Temperatures to 140 F.—*Hoke Inc., Cresskill, N. J.*

Circle **319** on Reader Service Card

SOLENOID VALVES

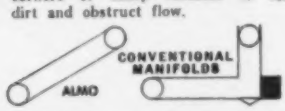
Hold operating position until energized even under 400 g. Meet MIL-S-901 B. For high impact shockproof equipment in hydraulic and

LET'S TALK MANIFOLD FACTS!

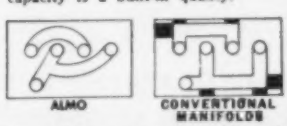
The advantages of (Almo) manifolds as opposed to other manifolds are many. Their unique design offers complete flexibility in the mounting of take-offs and valves. Thus an Almo manifold is more adaptable to your requirements. Here are 3 features that definitely effect performance, weight and size.

ALMO* HYDRAULIC MANIFOLDS

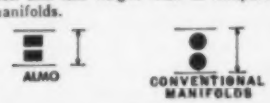
1. Flow lines are short as possible with no corners or sharp recesses to collect dirt and obstruct flow.



2. Method of construction permits better utilization of area, smaller overall dimensions and fewer complications while maintaining correct channel dimensions and constant operating pressures. PSI capacity is a built-in quality.



3. Rectangular cross section of flow lines makes possible thinner overall construction and less weight than in comparable manifolds.



WEIGH THESE FACTS!

Let us work with you in improving your product. Write for brochure.

ENGINEERING "A" RECOMMENDATIONS

*"THE UNIQUE FLUID CIRCUIT"

ALMO MANIFOLD & TOOL CO.

11472 KALTZ / CENTERLINE, MICH.

Circle **13** on Reader Service Card

pneumatic service. Two-position, direct-acting. Positive detents. Manual override optional. Sub-plate mounted.

Specifications: Service to 4000 psi, two solenoids, or 2000 psi, one solenoid and spring return.—*Republic Mfg. Co., Cleveland.*

Circle **320** on Reader Service Card

PNEUMATIC RECEIVER GAGES

Used in process industry. Features extra-wide, phosphor bronze Bourdon tube. Knife-edge pointer eliminates parallax error.

Continued on next page

Fall Wiper Ring SPRING LOADED

The Fall "CJ"* Wiper-Scraper Ring is Spring-Loaded causing Squeeze-Grip Action on the O.D. of the piston rod during entire cycle. This patented feature maintains a uniform, continuous pressure on the wiping edge of the ring at all times, stopping any buildup of foreign matter between the ring and the rod.

It automatically takes up wear, maintaining NEW RING PERFORMANCE. Available in diameters ½" through 13" for any commercial use. AN and MS numbers in use by the Military and Aviation industry since 1944. Manufactured in accordance with MIL-S-5049. (*Closed Joint)

ACE PRODUCTS CO.

1820 N. 12th St. Toledo 1, Ohio

Est. 1935

Circle **3** on Reader Service Card

GORTITE

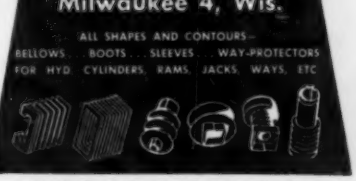
Pliable protection—fabricated to order without molds—BELLOWS . . . BOOTS . . . SLEEVES . . . WAY-PROTECTORS:

All GORTITE, protective parts are fabricated from new, neoprene-base materials, nylon-coated fabrics, fiberglass, Teflon, etc., to meet individual, service conditions: There are materials to withstand temperature extremes from —40° F. to 500° F., without cracking.

GORTITE protective parts are impervious to oil, grease, dust, dirt, sand, chemicals and abrasives. Bulletin AH-3 sent on request to—

A&A MFG. CO. INC.
712 S. 12th St.
Milwaukee 4, Wis.

ALL SHAPES AND CONTOURS—
BELLOWS . . . BOOTS . . . SLEEVES . . . WAY-PROTECTORS
FOR HYD. CYLINDERS, RAMS, JACKS, WAYS, ETC.



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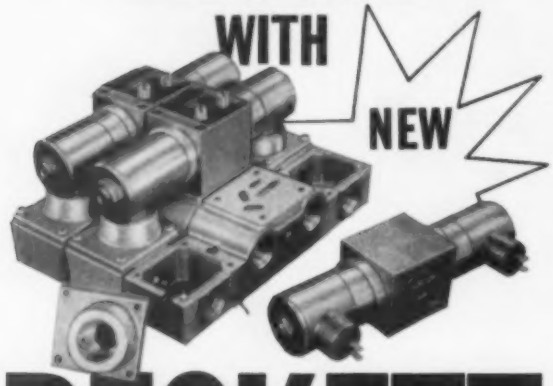
SAVE ON LABOR COSTS WITH NEW



BECKETT

Hi-Cyclic STACKING MANIFOLD AIR VALVES

- Change a valve in about 2 minutes or less without disturbing piping or wiring. Remove 4 bolts and lift off valve.
- Plug-in solenoid connections—no re-wiring needed to replace a valve.
- Large manifold capacity—add valves at any time, using same air supply.
- Manifold accepts 2 or 3-position, 1/4", 3/8" and modified 1/2" sizes. 1/4" valve mounts on 2 1/8" centers; 3/8" and modified 1/2" valves mount on 2 5/8" centers.
- Wide open bus duct-type wiring area makes for easy installation of electrics.
- Built-in speed controls—with instruction plate that identifies direction for speed regulation.
- These new Beckett Hi-Cyclic Air Valves provide fast reaction for accurate control. There are no working packings—seal is by precision metal-to-metal fit. Only the stainless steel spool and brass valve body in contact with media. Seven spool types are available to meet all requirements. New Hi-Cyclic Stacking Manifold Valves will save you money on direct labor costs for installation and replacement. Write today for full details.

DISTRIBUTORS IN MAJOR CITIES COAST-TO-COAST AND IN CANADA

NFPA MEMBER

BECKETT-HARCUM CO.

981 W. LOCUST STREET, WILMINGTON, OHIO

Circle **26** on Reader Service Card

NEW PRODUCTS

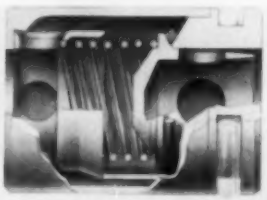
Specifications: Sizes 4½", 6", and 8½". Accuracy .5%, sensitivity .25%. To 24 psi.

Designation: Series 530.—*U. S. Gauge Div., American Machine and Metals, Inc., Sellersville, Pa.*

Circle **321** on Reader Service Card

CARTRIDGE-TYPE CHECK VALVE

Designed for single-bored hole. Eliminates threaded connections and expensive machinery.



Specifications: Steel or aluminum, from ¼" to ¾". Pressures to 5000 psi.

Designation: C-200.—*Circle Seal Products Co., Inc., Pasadena, Calif.*

Circle **322** on Reader Service Card

RADIATION RESISTANT COMPOUND

O-ring material has resistance to effects of radiation, air, water, fuel, and oil. Used in wide range of fluid applications involving nuclear systems. Hours of expected life equals maximum radiation per hour divided by radiation rate in roentgens per hour.

Specifications: Gamma radiation resistant to 1 x 10^9 roentgens, regardless of exposure time. Temperature from −40 to 300 F oil, 250 F air.

Designation: Compound 1387.—*Precision Rubber Products Corp., Dayton, Ohio.*

Circle **323** on Reader Service Card

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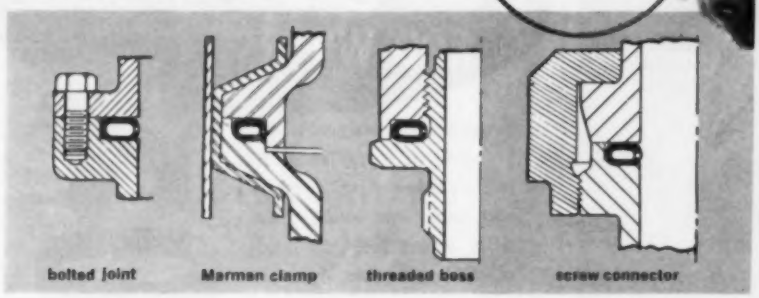
Circle **172** on Reader Service Card

PRESSURE-TIGHT JOINTS 10^{-6} mm Hg–100,000 psi



United Self-Energized Metallic O-Rings...*

form positive, permanent, non-corrosive, static seals under pressure extremes from 10^{-6} mm Hg to 100,000 psi (or the ultimate compression stress of the metal itself) and temperatures from −452° to 3000° F. Available in various metals and coatings (including Teflon** and silver) ¼" O.D. to any size and configuration. United also makes non-vented and pressure-filled O-rings.

United Metallic "O" Rings, manufactured by United Aircraft Products, Inc., Box 1035, Dayton, Ohio.

See United Metallic O-Ring Catalog in Sweet's Product Design File or write for Free Handbook

*Patents 2,909,269; 2,837,360
**DuPont registered trademark

FLUID & AIR CONTROL VALVES
DESIGNED FOR VOLUME USERS

★ LOW-COST
★ DEPENDABLE
★ VERSATILE
★ TROUBLE-FREE

SPECS IN BRIEF...

SIZES: ⅛" to ¾" NPT.

PRESSURE RANGES: Up to 2000 PSI for brass and aluminum. Up to 5000 PSI for steel or stainless.

MATERIALS: Stocked in brass and steel. Available in stainless, aluminum, and other alloys to order.

FEATURES: Low initial cost and less maintenance. High flow-to-size ratios. "Straight-thru" principle cuts friction loss and clogging. Easy to install.

USED BY the biggest names in American industry . . . and in military applications.

DESIGN MANUAL

Complete specifications and design aids in handy file-size folder is yours on request. Write on letterhead or use inquiry card.

TRUE-FLO® VALVE company, inc.

792 Bow St., Everett 49, Mass.

CHECK VALVES

'Straight-thru' design for highest flow and dependability. Free-moving ball principle.

FLOW CONTROL VALVES

Adjust flow rate (in stepless ranges) with common screwdriver before, during, or after easy installation.

DUAL CONTROL VALVES

Unique . . . controls flow in both directions independently! True 2-way control for little more than the cost of one flow control valve.

Circle **170** on Reader Service Card

ELIMINATE THOSE PROBLEMS—reduce maintenance and down-time—step-up production and solve the problem of costly repairs and replacement of air tools.

Compact package unit solves all three problems simultaneously.

- **Regulates**
- **Lubricates**
- **Filters**

Easily installed — only 2 connections

AIR EQUIPMENT and tools give top performance when the "working" air stream is
accurately regulated
efficiently lubricated
and free of dirt, grit, scale and water.

REGULATOR

BALANCED PISTON regulator maintains accurate regulation—balances air surges —automatic bleed-off. — long trouble-free service.

FILTER

DUAL FILTERING–CYCLONIC action—clean uncontaminated air—eliminates costly repairs, maintenance and replacement of air tools due to dirty air. Less down-time.

LUBRICATOR

AUTOMATIC FOG MIST lubrication prevents rusting and scoring—reduces costly repairs and replacement of air tools. Won't flood.

PSC complete line of single and combination controls listed in Bulletin 80. Send for copy today.

QUICK DISCONNECTS

The fast, easy operating PSC Disconnects permit quick, economical making and changing set-ups. Less down-time—more production time.

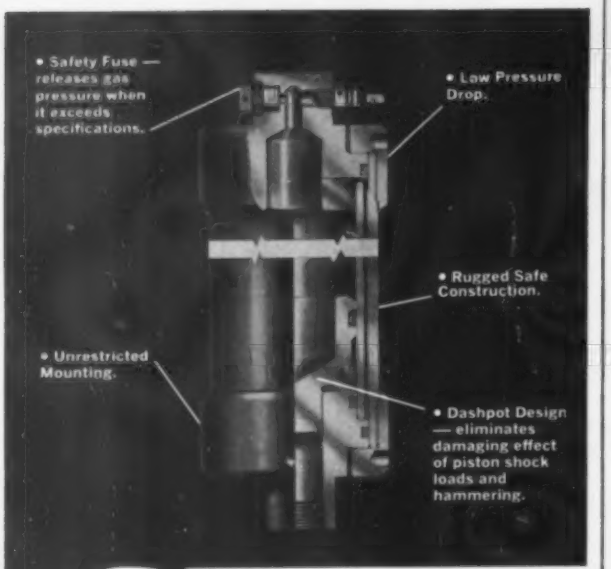
Ask for BULLETIN 1475 and get complete details and engineering data on PSC Disconnects.

PERFECTING SERVICE CO.
332 Arando Ave. Charlotte 6, N. C.
Baltimore · Buffalo · Chicago · Cleveland · Camden · Los Angeles · New York · Providence · Montreal · Toronto · Canada

Circle **135** on Reader Service Card

SUPERIOR

In Design, Performance And Maintenance–Free Service


• Safety Fuse — releases gas pressure when it exceeds specifications.
• Low Pressure Drop.
• Rugged Safe Construction.
• Unrestricted Mounting.
• Dashpot Design — eliminates damaging effect of piston shock loads and hammering.

Superior

Piston Type ACCUMULATORS

...a wide range of dependable double shell and single shell A.S.M.E. approved models are now available for any industrial or military application.

The Superior accumulators are the product of over ten years of design, development and manufacturing experience.

Proven in critical installations, the Superior accumulators incorporate the most ideal combination of design and performance characteristics ever offered. The design features a permanent piston for long-life, trouble-free service — no diaphragm or bladder to replace.

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Territories available for qualified distributors.

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Division of Superior Pipe Specialties Co.

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Circle **91** on Reader Service Card

PROTECT VITAL HYDRAULIC PARTS with *Seal-Guard* METALLIC ROD WIPERS

Bronze, knife-edged rings, mounted in a synthetic rubber cushion ring, remove rust, scale and foreign particles before they can reach vital internal parts. The cushion ring, compressed on assembly, exerts constant pressure on the bronze rings. Rings will not mar the rod, are oil and heat resistant and friction-free. Packing failures are literally "wiped out"!

Available in standard sizes for ¼ to 6 inch rod diameters. Larger sizes up to 24½" diameter by special order.

Detailed literature on request

HYDRAULIC ACCESSORIES CO.
24201 Hoover Road · Warren, Michigan

new ROTORAM® VALVES

WITH EXCLUSIVE ROTATING STEM

for MILLIONS of TROUBLE-FREE ACTUATIONS

Treadle Valve

Knob Valve

- Low silhouette mounting
- 2024 T4 aluminum bar stock
- Rust-resistant
- Full flow air passages
- Piped exhaust ports
- Interchangeable parts
- Anodized finish

Cam Valve

Finger Valve

Pedal Valve

Hand Ball Valve

Rotoram Valves are available in 3 and 4-way models for ⅛", ¼", ⅜" and ½" pipe sizes. Special Block "V" Packing permits free ram movement, insures long valve life. Port entry from either left or right side. Ask your AIR-MITE Distributor, or write for complete details and illustrated catalog.

AIR-MITE DEVICES, INC.
4401 W. Kinzie St., Chicago 24, Ill.

Circle **11** on Reader Service Card

NEW LITERATURE

Continued from page 90

INDUSTRIAL O-RINGS

For gas, air, water and oil. Data on four compounds used for sealing. SR 310-70 and SR 303-90 (Buna-N), and SR 592-70 and SR 593-90 (Neoprene). Strengths to 2700 psi. Shore durometer hardnesses of 70 and 90. Illustrations and applications.—*Stillman Rubber Co., Culver City, Calif.*

Circle **414** on Reader Service Card

CLAMPING CYLINDERS

Bulletin 91036 shows features and specifications. Bore sizes 1½", 2¼", 3". Single or double acting. From 0 to 150 psi. Base or foot mounted. Heavy duty construction with cast bronze body.—*Airmatic Valve, Inc., Cleveland.*

Circle **415** on Reader Service Card

BALL VALVE

Molded of unplasticised polyvinyl chloride. Permits full flow with no pressure drop. Maintains high dimensional stability. Teflon seats and Neoprene O-rings. Cleaning and maintenance can be handled without removing from line. Size to 3". Pressures to 125 psi. Shut-off with ¼ handle turn. Temperatures to 140 F.—*Hoke Inc., Cresskill, N. J.*

Circle **416** on Reader Service Card

RUBBER HOSE, BELTS

Shows applications of hose and belts in foreign countries. Includes V-belt drives for ice breakers, water pumps, stone plants, atomizers, generators, and rip saws; flat belt drives for sheet metal equipment; hog scrapers in meat packing plants; flexible hose for cake-icing machines; and sheaves for milling machines.—*Gates Rubber Co., Denver.*

Circle **417** on Reader Service Card

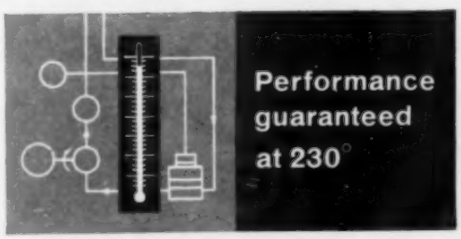
IMPULSE COUNTER

For fluid metering. Positive detent setting. Indicator shows counts remaining before contact action.

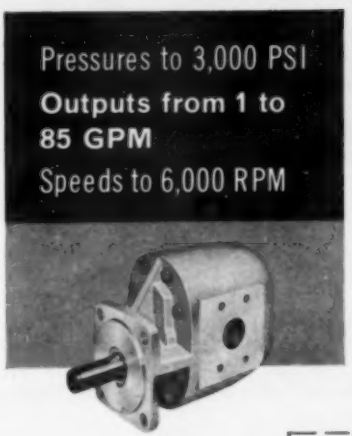
Continued on next page

BERRY/DOWTY* gear pumps

The Berry/Dowty line of hydraulic gear pumps has been subjected to exhaustive endurance tests. A Model GPA3/170 (rated output 24.5 GPM at 1800 RPM and 2000 PSI) was put through a one million cycle 0-2000 PSI test, with the final 200,000 cycles at 230° F. There was no measurable wear as a result of this test. In this and other tests, volumetric and mechanical efficiency has increased slightly from beginning to end of test, a result of the self-compensating design.



Performance and warranty are unaffected by system temperatures of 230° F. provided minimum operating oil viscosity is 50 SSU. Volumetric efficiencies of 95% at 2000 PSI are normal under these conditions.



Value analysis (price, performance and reliability) proves the economy of Berry/Dowty Hydraulic Gear Pumps. Wire or phone today (Corinth, Miss., ATlantic 6-5541, Dept. K) for test units for evaluation on your equipment.

Berry HYDRAULICS
A DIVISION OF OLIVER TYRONE CORPORATION

*Dowty is the trademark of Dowty Hydraulic Units Limited, England

MAIL FOR NEW GEAR PUMP CATALOG
Berry Hydraulics Corinth 1, Miss.
Name_____
Company_____
Address_____

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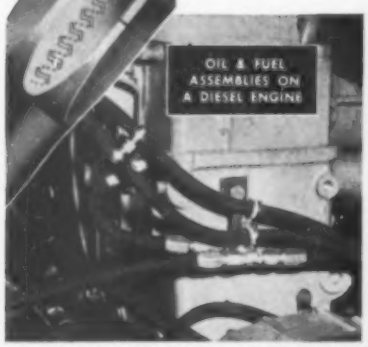
LONGER-SERVICE HOSE ASSEMBLIES FOR EVERY REQUIREMENT

STRATOFLEX HOSE & FITTINGS



VIBRATION PROOF • LEAK PROOF • ABRASION RESISTANT

Manufacturers and users of equipment requiring hose assemblies can depend on Stratoflex flexible hose and hose fittings to reduce downtime through availability, thereby holding maintenance costs to a minimum. Designed for diesel, automotive, general industrial and commercial applications, Stratoflex hose and fittings have the proven durability that is necessary for dependable service. Stratoflex hose and fittings are available in a wide variety of sizes and types to meet every requirement. Shown above are typical installations where Stratoflex hose and fittings are giving economical, dependable service.

For complete information, write for S-2 bulletin. SF1-1

STRATOFLEX Inc.

P.O. Box 10388 • Fort Worth, Texas
Branch Plants: Hawthorne, Calif., Fort Wayne, Ind.
In Canada: Stratoflex of Canada, Inc.
In Great Britain: Stratoflex (U.K.) Ltd.

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Cleveland, Dayton
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Fort Worth, Hawthorne
Houston, Kansas City
Milwaukee, New York
Orlando, Philadelphia
Pittsburgh, San Diego
San Francisco, Seattle
Toronto, Tulsa

Circle **161** on Reader Service Card

NEW LITERATURE

At zero the load contacts actuate and counter resets to start position, or remains at zero, depending on circuit arrangement. Count range 1 to 120. 500 counts per minute for single batch count control. 300 counts per minute for continuous repetitive count cycles. 50 milliseconds impulse duration. Advance ½ count when energized, ½ count when impulse breaks. Bulletin N 310.—*Automatic Timing & Controls, Inc., King of Prussia, Pa.*

Circle **418** on Reader Service Card

COMPRESSOR ACCESSORIES

For use with new compressors or for air systems already in operation. Includes dual control system, unloaded starting delay system, by-pass type crankcase oil filter, drive belt guard, intercooler guard, watercooled aftercooler, low pressure safety switch, intake air silencer, air receiver, and drain valve. Pressures to 200 psi. 0 to 300-psi pressure gage. Safety valve for 125- and 175-psi operation.—*Le Roi Div., Westinghouse Air Brake Co., Sidney, Ohio.*

Circle **419** on Reader Service Card

AIR COOLED HEAT EXCHANGERS

New specification sheet enables manufacturers to improve deliveries, provides information which previously had to be obtained after orders were received.—*Air Cooled Exchanger Manufacturers Assoc., New York.*

Circle **420** on Reader Service Card

NONDESTRUCTIVE TUBE TESTING

Article on nondestructive testing of small diameter tubing gives description of how tests are applied. Advantages and limitations. Tests include visual magnification, boroscope, eddy current, dye penetrant, magnetic particle, ultrasonic, radiographic, and hydrostatic. Two-page table rates each test with respect to its most important factors.—*Superior Tube Co., Norristown, Pa.*

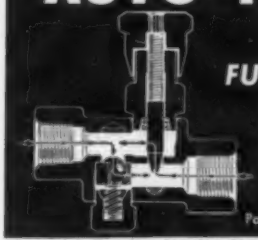
Circle **421** on Reader Service Card

Continued on page 178

Circle **23** on Reader Service Card

AUTO-PONENT®

HYDRAULIC FULL FLOW VALVES



Flow Control, Needle, Check, for HYDRAULIC Power

Model KF Flow Control Valve with Dial and Knob adjustment for direct reading and duplicating reference. Now available in Aluminum for 3000 psi.

Pat. #2,841, 174

A complete line: ⅛", ¼", ⅜", ½", and ¾" female Dryseal Pipe Sizes in all models and types. Equivalent Aeronautical Tube Sizes on special order.

MINIMUM PRESSURE DROP AND POWER LOSS . . . Oversize ports and passages give maximum flow at minimum pressure drop, insure greater accuracy and response in hydraulic or large volume air cylinder control.

EASY FLOW ADJUSTMENTS under full pressure. Seal located at port to eliminate air or dirt traps. Gland structure equally effective on pressure or vacuum.

SENSITIVE, CHATTERLESS BALL CHECK . . . Patented design insures rapid ball movement to open or close at low differentials.

FORGED BODIES permit higher pressures with wide safety margins. Aluminum—3000 psi; Steel and Stainless Steel—5,000 psi. Pressure ratings based on better than 5 to 1 safety factor. All internal parts are Stainless. Write for illustrated catalog.

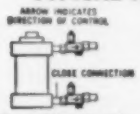
Model F Standard Flow Control Valve or Model N Needle Valve

Model KF Knob and Dial Flow Control Valve or Model KN Needle Valve.

Model PF Knob and Dial Flow Control Valve or Model PN Needle Valve for panel mounting.

Model C Check Valve for In-Line Mounting.

TYPICAL APPLICATIONS



Controlling Double Acting Cylinder

Controlling Single Acting Cylinder

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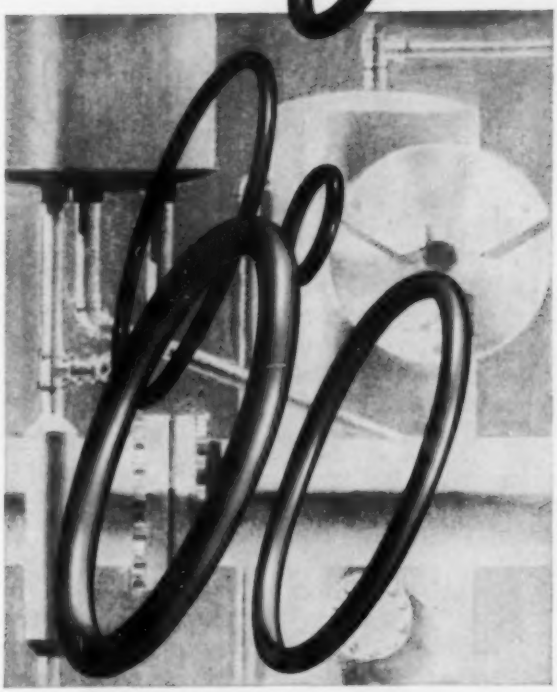


Through Stillman Technology and volume production, Stillman high-quality O-Rings are available at extremely low cost. The same quality and reliability that are engineered into O-Rings for the aircraft and missile industries are also featured in the new Stillman Industrial O-Rings. These all-purpose seals are designed for use in all phases of industrial sealing, and are uniformly high in important features of chemical resistance, low swell, long life, and sealing dependability. Stillman O-Rings are stocked in a complete range of sizes for rapid delivery.

Write for the all-new Stillman Industrial O-Ring brochure, free on request.

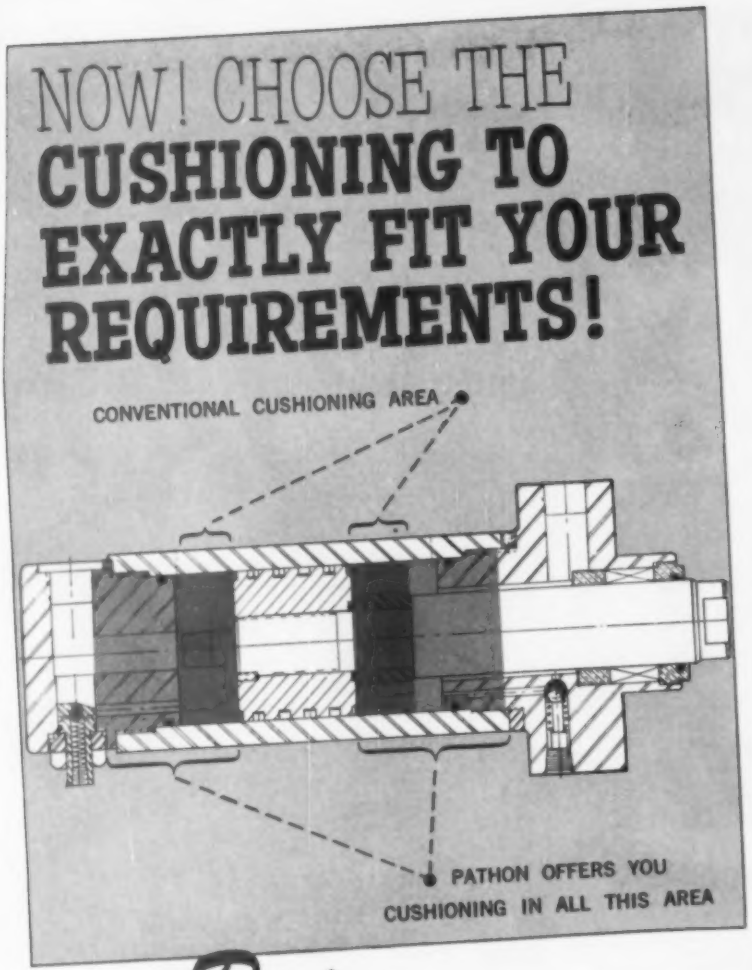
NOTE: *Major distributorships still available in some major cities.*

STILLMAN RUBBER COMPANY

Culver City, Calif./Cleveland, Ohio/Englewood, N.J.

Circle **160** on Reader Service Card

NOW! CHOOSE THE CUSHIONING TO EXACTLY FIT YOUR REQUIREMENTS!



Another **Pathon** *First !*

High speed cylinder operations frequently require more refined deceleration techniques than ordinary cylinder cushions.

Now, Pathon cylinders are available with adjustable or non-adjustable cushions that are three to four times longer than ordinary cushions to provide the effective control required.

This extra length does not increase standard catalog dimensions and you can customs-specify any length or configuration up to the maximum.

Write for "LET'S TALK CUSHIONS" for details.

Pathon MANUFACTURING COMPANY

3823 Pacific Avenue, Cincinnati 12, Ohio

FLUID OPERATED AND CONTROL EQUIPMENT

Circle **134** on Reader Service Card

NEW LITERATURE

REGULATORS AND VALVES

Bulletin J-D1 illustrates sliding gate seats in ductile iron valves and regulators. Self-cleaning and self-lapping. No wire drawing. Linear and straight-through flow. All metal construction, properties and specs given. Describes valves to 250 psi, 500 F. Sizes ¼" to 6".—*OPW-Jordan Corp., Cincinnati.*

Circle **422** on Reader Service Card

FLUID POWER COMPONENTS, SYSTEMS

Distributor bulletin shows equipment for industrial and mobile hydraulic, and pneumatic applications. Includes pumps, valves, cylinders, motors, rotary actuators, accumulators, regulators, filters, and power units. Design and manufacture of hydraulic test stands to 5000 psi, 150 gpm. Special machines for atomic energy, metalworking and process industries.—*Rucker Co., Oakland, Calif.*

Circle **423** on Reader Service Card

MACHINE TOOL MOTORS

Pre-lubricated and pre-sealed. Periodic bearing regreasings eliminated. Cast-iron housing. Straight-through ventilation gives drip-proof protection regardless of mounting position. Unitized stator and balanced, die-cast rotor.—*Westinghouse Electric Corp., Pittsburgh.*

Circle **424** on Reader Service Card

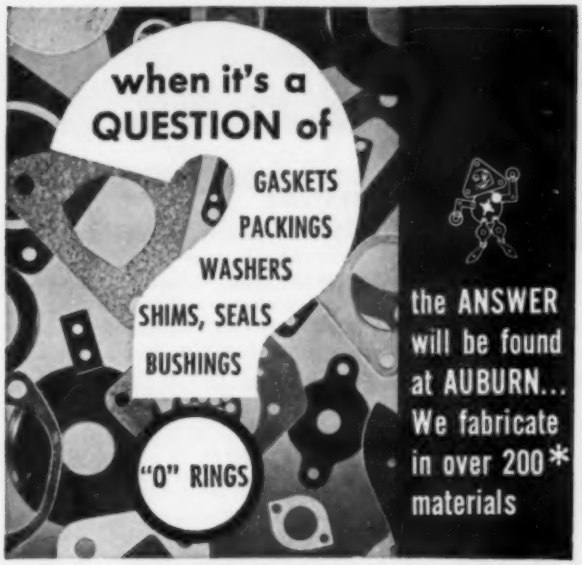
AIR VALVES, CYLINDERS

Miniature cylinders, sizes ¾" to 2½". For air, water, or oil. Pressures to 500 psi. Valve-cylinder combination, bore sizes 1", 1¼", 1½", and 2". Pressures to 1500 psi. Clamp cylinders, bore sizes 1½", 2¼", 3". Pressures to 500 psi. Includes pin-operated double acting, and C-clamp cylinders. Others, single and double acting. 2-way valves to 500 psi, sizes ¼" to 3". 3-way, sizes ¼" to 1". Includes 4-way valves, and miniature 2-, 3-, and 4-way valves to 1500 psi. Bulletin 95051.—*Airmatic Valve, Inc., Cleveland.*

Circle **425** on Reader Service Card

Continued on page 180

Circle **20** on Reader Service Card



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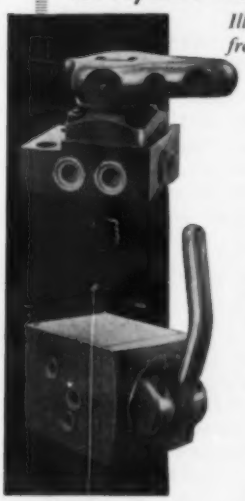

Illustration shows two examples from the wide range of valves

MBL.3128/1 (Top)

- 2-way selector valve feeds pressure to selected service (e.g. double-acting ram) leaving alternate selector position open to exhaust
- Selector handle in neutral position opens both selector connections to exhaust
- Other selector arrangements designed to customers' requirements

MBL.3405 *Prov. Pat. No. 34977/59* (Bottom)

- Single lever-operated valve actuates set of 4 chocks or single acting rams in pairs or sets of 4
- Separate selector valve incorporated to operate double-acting ram
- All operations, both pressure and exhaust, controlled by single selector lever
- 2 relief valves yielding at 6,500 p.s.i., fitted to valve body or installed separately
- Normal fluid — water and soluble oil

Full details gladly supplied on request.

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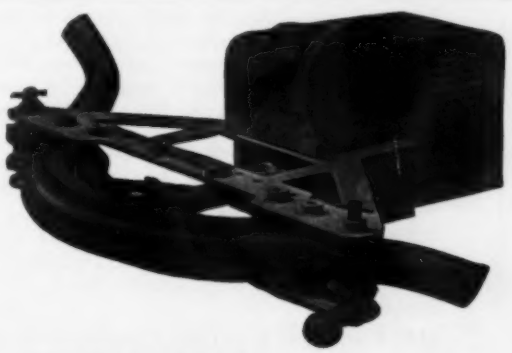
STAFFA

HIGH TORQUE VARIABLE SPEED (1-100 r.p.m.) HYDRAULIC MOTORS

Mark IV—5 cylinder 4,500 lbs. ft. at 2,000 p.s.i. (Speed 1—100 R.P.M. reversible). Overall efficiency 90%—95%.
Mark V—7 cylinder 6,600 lbs. ft. at 2,000 p.s.i. (Speed 1—75 R.P.M. reversible). Overall efficiency 90%—95%.
Ideal drive for conveyors, rolling mills, cranes, tractors, cement mixers, drills, and most mechanical handling applications.



4" HYDRAULIC BENDER

Standard equipment includes 2"—4" formers for steam and gas pipes. The machine can be supplied either **Hand Operated** or **Motorised** and accessories are available for ⅜"—1½" steam and gas pipes, flat bar bending up to 7" x ¾" section and electrical conduits up to 3".

A complete range of Hydraulic Pipe and Tube Benders ¼" to 18" dia. Pipes is available.

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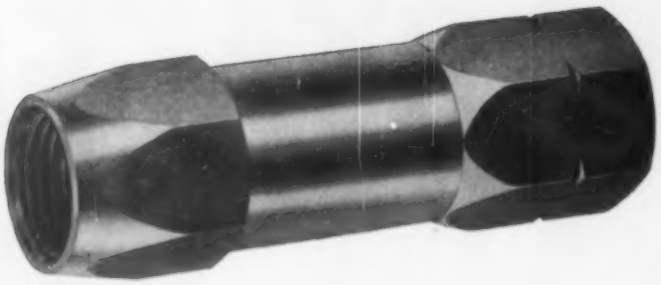


New from Bruning– AN EXCELLENT CHECK VALVE, YET PRICED BELOW MOST OTHERS

We could have used superlatives, but we would rather they came from you after you have tested this new "Deccto" check valve. It is one we honestly believe offers a number of distinct advantages over others costing far more.

In setting out to design the "Deccto" Series, we made economy a prime objective. Having completed comparative testing, we were pleased to find we had been unusually successful in several other ways, too.

New "Deccto" Series check valves are not only substantially less expensive than similar products, they incorporate superior design features that are readily apparent to the discerning user. We think you will be as enthusiastic as we are when you have noted their performance characteristics.

Some of them are mentioned here:

SURGE-PROOF OPERATION A hydraulic deceleration device neutralizes surge-shock.

MAINTENANCE-FREE PERFORMANCE Our tests show the "Deccto" improves with use, hitting its stride, so to speak, about the time similar check valves are ready for replacement.

LEAK-PROOF CHECK ACTION Precision knife-edged, line-contact, metal-to-metal valve seat insures performance equaling or exceeding military specification.

OPERATING PRESSURE 3000 PSI AND UP, with extremely low pressure-drop at rated flow.

OPERATING TEMPERATURES –250°F to +500°F Absence of dissimilar materials eliminates problems of differential expansion and contraction. No elastomer seal problems.

Confident of the worth of this new series of check valves, we earnestly invite inquiries, once again reminding you of the low prices we have set for this product. We would be pleased to send a sample.

THE BRUNING COMPANY

LINCOLN, NEBRASKA

Phone – HE 5-3511 • TWX – LI 8151

Circle **34** on Reader Service Card

NEW LITERATURE

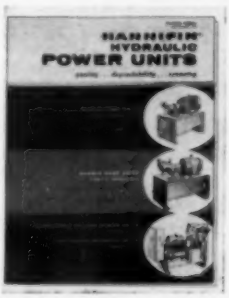
COMPONENTS AND SYSTEMS

Bulletin describes design and engineering of fluid power components and systems, including pumps, valves, motors and cylinders. Specifications and illustrations.—*Air line Equipment Co., Inc., Philadelphia.*

Circle **426** on Reader Service Card

POWER UNITS

Application information in bulletin 0980-B1 covers 37 units. Twelve 1000- and 2000-psi single pump models, fifteen double pump



models of similar capacities, and ten continuous booster models with automatic pressure intensification to 5000 psi. Table relates gpm delivery to horsepower input. *Hannifin Co., Div. Parker-Hannifin Corp., DesPlaines, Ill.*

Circle **427** on Reader Service Card

CYLINDER PARTS INFORMATION

Simplified parts ordering with model code table. Illustrations and internal views. Model designs 13 and 20. Shows single and double rod end construction. *Vickers Inc., Machinery Hydraulics Div., Detroit.*

Circle **428** on Reader Service Card

SILICONES

What they are, how they can be used. Charts cover properties and features of fluids, resins, rubber compounds, water repellents, antifoams and emulsions. Graphs and illustrations.— *Silicones Div., Union Carbide Corp., New York.*

Circle **429** on Reader Service Card

▼▼▼

Circle **106** on Reader Service Card

NEWS FROM THE ORIGINATORS OF METAL-SEAL FITTINGS

the **'CN'** metal-seal tube fitting **SEALS** **ALL** straight-thread ports

Seal Ports in ALL Base Metals—Steel, Cast Iron, and Aluminum: L & L's 'CN' fittings are now made with a new special metal seal ring that works perfectly no matter what the component base metal.

Seal ALL Straight-Thread Port Designs—There's no change in the ability of 'CN' fittings to seal perfectly the S.A.E. port design, as well as the UN port design (the ultimate port for both O-ring and metal seal fittings).

Captive nut wedges the metal seal ring into port angle. Resulting seal is unaffected by vibration, exotic fluids, high temperatures. Seal can be remade repeatedly.

Write for "Leak-Proof Port Connections"

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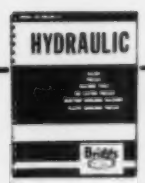

HERE IS A BIG 8½" x 11", file size 12 page, fully illustrated booklet. It's brimful of technical data and drawings that every designer and operating engineer will want to read and keep for ready reference. Write for your copy. No obligation.

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✓ efficiently
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is as easy as . . .

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PROVEN QUALITY SP CYLINDERS • BOOSTERS

SERIES A

Standard Cylinders AIR or OIL Without Modification

Save money with S-P's complete line; rated 200 psi air, 500 psi oil or water; 23 mounting types; 11 bore sizes—1½" thru 14"; see Catalog 110C.

SERIES B

HIGH PRESSURE Hydraulic Cylinders

Get smoother, more precise power; ruggedly built, interchangeable; 2000 psi (3000 psi non-shock); 12 bore sizes—1⅛" thru 12"; get Catalog 117.

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Save money, save space; boost 80 psi line air to 3000 psi hydraulic power with no added power consumption, no maintenance; see Catalog 116.

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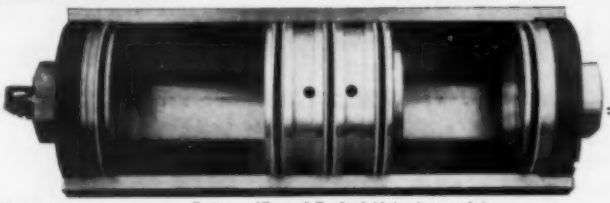
for Reliability—Quality—Delivery

HALE **Piston Type ACCUMULATORS**



Cutaway View of Typical Hale Accumulator

for:
- **Auxiliary Power**
- **Leakage Compensator**
- **Surge Dampener**
- **Emergency Power**

featuring:
- **Self-Balancing Piston**
- **Triple "O" Ring Seal**
- **Auto-Relieving Piston**

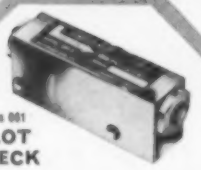
The HALE Piston Accumulators feature a unique piston design which assures long seal life and no air or oil leakage. The free piston contains three "O" ring seals, all of which are active members. Any air or oil trapped between two seals is automatically discharged to its respective chamber during each piston stroke.
The end caps, accurately machined to receive the piston for dashpot action, use the same "O" ring seals as the piston, thus requiring only one seal size as spare parts.

***Send Today!** For new, supplemental Illustrated Bulletin No. 387.*

Write to FLUID POWER DIVISION

HALE FIRE PUMP COMPANY
CONSHOHOCKEN, PA.

WATERMAN



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PILOT CHECK
Only 25% of line pressure required for pilot to open valve. Compact and light in weight. ¼" and ⅜" N.P.T.F., 3000 p.s.i.

Series 271
LOCK VALVES
Simple, positive, low-cost way to prevent cylinder creep due to leakage of spool valve. ¼" to ¾" N.P.T.F., 3000 p.s.i.

Series 660
COUNTERBALANCE VALVES
Smooth, positive control of negative loads. Cylinder speed proportioned to pump output. ½" and 1" N.P.T.F., 3000 p.s.i.

Simplify hydraulic system design while you get improved performance. Why settle for halfway measures when you can specify a Waterman valve *designed* for these and other special purposes?

Send today for valuable Catalog 3001

NFPA

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BEST WAY TO SEAL HOLES!

LEE PLUG

Simply place plug in reamed hole. Drive in tapered pin until ends are flush. Controlled expansion causes grooves to "bite" into casting, assures a bone dry seal that withstands pressures up to 40,000 psi. Now widely used on aircraft and missiles, and for pumps, servo valves, regulators, etc.

*Pat. #2,821,323

LEE COMPANY
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POST SCRIPTS OF INDUSTRY

Racine appoints vice president, manager

Verhaeghe

George A. Verhaeghe has been named vice president of sales of hydraulic products for Racine Hydraulics & Machinery, Inc., Racine, Wisconsin. Verhaeghe has been with Racine for 14 years. He had been in charge of hydraulic sales for the past several years. Clare Hellenberg was named manager of the Mobile Hydraulic Div. He will continue as chief engineer. Hellenberg has been with Racine since 1957. He was formerly a mobile hydraulic specialist with Vickers, Inc.

Greer gets new board members

In a reorganization of corporate management, Barney B. Hayden, vice president of Precision Sheet Metal, Inc., was elected to the board of Greer Hydraulics, Inc., Los Angeles. Hayden has extensive experience with air-craft and military customers. John L. Hill was also elected a director. He is vice president and director of Hill Richards & Co., Inc. investment bankers in California.

Denison names manager of Marysville plant

Bohannan

William F. Bohannan has been named manager of the new plant to be erected at Marysville, Ohio by Denison Engineering Div., American Brake Shoe Co., Columbus. Bohannan will be responsible for all operations of the new plant which will reach full scale production of hydraulic axial piston pumps and valves later this year. Bohannan joined Denison in 1951 as an assistant to the general manager, and was later appointed supervisor of the research laboratory. He has been manager of the product de-

Continued on next page

PARCO PROBLEM PROBERS ???... FAILURE-PROOF BONDING

!!! If your product design includes components where rubber is bonded to metal, how can you be sure that these bonds are failure-proof? There is no known method for testing a bonded joint except by testing to destruction. Failure-proof bonding must be accomplished during component production, not ascertained by subsequent tests. ○ This is where Parco's research, process control, scientifically designed production equipment, exacting production techniques and experienced personnel pay huge dividends in bonded joint quality and dependability. ○ Parco laboratories have thoroughly researched the bonding of rubber to metal and have developed precise and scientific process controls which assure consistent, fail-proof results. Bonding is accomplished with shop equipment *specifically designed for this specialized purpose*, and by Parco operators with years of experience in bonding. ○ Consult with Parco engineers regarding rubber-to-metal bonded joints which are stronger than the rubber itself.

Send for your latest Parco Slide Rule

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Los Angeles 47, California

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Please send the Parco O-Ring Data Chart to:

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COMPANY_____
BUSINESS ADDRESS_____
CITY_____
ZONE____ STATE_____

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POST SCRIPTS OF INDUSTRY

sign group where he supervised modification of newly designed hydraulic products to adapt them for production. His present position is chief engineer.

Polymer opens new service facility

Polymer Corp., Reading, Pa., opened a new facility in Industrial Park, Rolling Meadows, Ill., for its subsidiary, The Polymer Corp. of Penna. Polymer has engineered and distributed plastic stock shapes in the midwest since 1947.

Parker-Hannifin moves Los Angeles office

Parker-Hannifin sales office for industrial components in the southwestern region has moved from Los Angeles to Culver City, Calif. Regional manager in this office is D. G. Henderson. Sales engineers include Dale R. Thompson, Frank W. Cowdrey, and C. Q. Hagerty. This group will handle all Parker-Hannifin pneumatic and hydraulic products including cylinders, control valves, presses and power units, lubricators, filters and regulators, fittings, accumulators, and machinery.

Marsh promotes 3 in sales

Warner

Don L. Warner was made assistant sales manager of Marsh Instrument Co., Div. Colorado Oil & Gas Corp., Skokie, Illinois. Jack Kelly succeeds Warner as manager of the Philadelphia district, including eastern Pennsylvania, New Jersey, District of Columbia, Maryland, and Delaware. Warner and Kelly have been with Marsh for ten years. Robert Ely is manager of the midwestern district, including Illinois, Indiana, western Michigan, Iowa, Nebraska, Missouri, Kansas, Colorado, Wyoming, and Montana. He was a sales representative.

New president at Weinman

C. Dana Chalfant has been elected president of Weinman Pump & Supply Co. Pittsburgh. C. E. Chalfant, who had been president and chief executive officer, became chairman of the board.

C. D. Chalfant

Paneitz

Oilgear announces Chicago district office

Oilgear Co., Milwaukee, will have their sales, service and application-engineering office located in Villa Park, Ill. Clarence H. Paneitz will direct the sale of components in this territory. He has been with Oilgear since 1935. Vitious P. Jurkonis will be engineering representative in the area. He has been an application-engineering representative in the midwest since 1946.

Borden expands in component supply

A. E. Borden Co., Inc., Boston, has entered the complete fluid

Continued on page 186

DEPENDABILITY

THESE HANDS DARE TO TEST THEIR SKILL

with rigid, station-by-station inspection. CROSS hydraulic cylinder dependability is not left to chance. Every component must conform to the industry's highest standards — standards set at CROSS with faith in the workers' skills. Their pride of craftsmanship is your guarantee of quality. For a cylinder to withstand severe pressures, corrosive atmospheres — look to CROSS.

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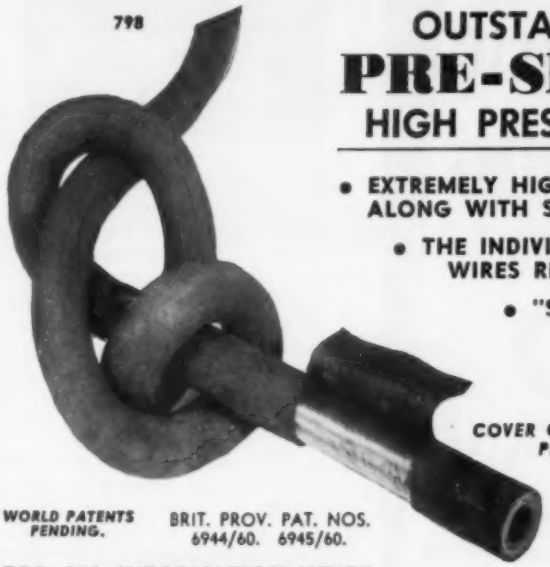

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• Four curved vanes scoop up large volumes of air—provide 2 to 3 times more air space. Mounted on easy-action hinges to assure perfect contact with cylinder walls by centrifugal force. Vanes and cylinders made of durable cast iron (no composition). Hone themselves to hard, glassy smoothness to assure leak-proof seal and reduce frictional wear. Negligible wear is automatically taken up by rotating vanes.

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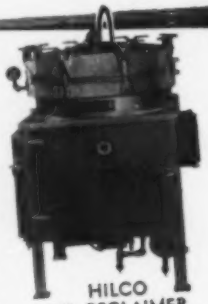

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POST SCRIPTS OF INDUSTRY

component supply field. Their services will be offered in New England. The company's line includes Imperial-Eastman fittings, tools and hydraulic hose. Borden has branch warehouses in Portland, Maine; Providence, R.I.; and soon in Manchester, N. H.

Wilkerson appoints Cozard

Wilkerson Corp., Englewood, Colorado, put William Cozard in charge of Southeastern regional sales. Cozard has been in the company's sales department for eleven years. From 1954 to 1957, he was sales manager. Then he retired to Florida and founded Air Devices Corp, of which he is still president.

You can win up to $500 by entering the 1961 FLUID POWER PRIZE PAPER CONTEST

For details circle 220 on reader service card

Bendix names western representative

Frank E. Hibbard was appointed pacific coast regional manager of the Bendix Industrial Controls Section, Detroit. Hibbard has twenty years of sales and engineering experience.

Reck

Hibbard

Jamesbury names sales executives

Maxwell H. Reck, asst. sales manager of Jamesbury Corp., Worcester, Mass., for the past three years, was named sales manager. W. G. Hurd, formerly Jamesbury district sales manager for southeastern United States, succeeds Reck.

Continued on page 188

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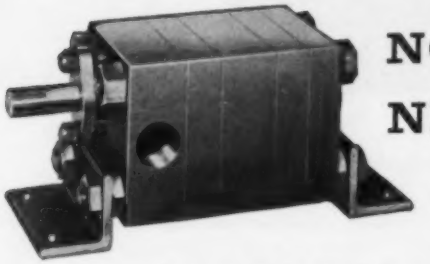

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Subsidiary of NORTHERN PUMP COMPANY

Minneapolis 21, Minnesota

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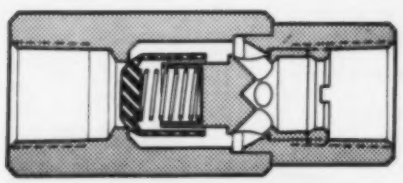

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- Non-adjustable — 15, 45 or 65 psi
- For oil to 3000 psi
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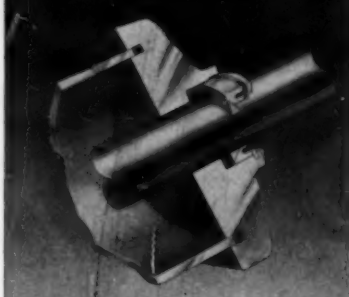

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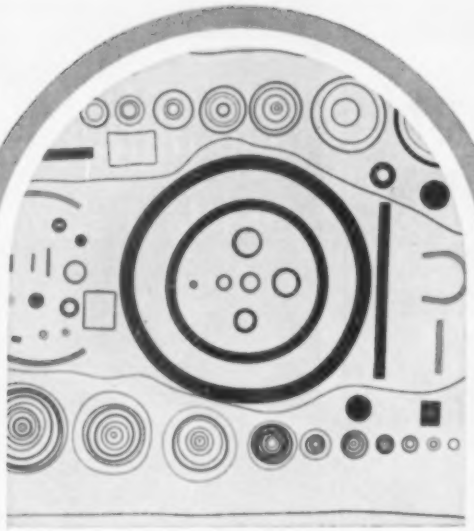

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POST SCRIPTS OF INDUSTRY

New distributors

Haskel Engineering & Supply Co., Glendale and San Francisco, has been appointed national distributor and western factory representative by Del Manufacturing, Los Angeles. Haskel will handle two new seals used in industry and missiles. They will be exclusive agent in the 11 western states and will appoint manufacturer's representatives in industrial areas.

Norwalk Co., Inc., South Norwalk, Conn., manufacturer of high pressure air and gas compressors, has been appointed distributor for Bauer compressors, made in Western Germany. The Bauer compressors will supplement the full range of heavy Norwalk models.

Humphrey Products, Div. General Gas Light Co., Kalamazoo, Mich., has appointed the following distributors to sell air valves and pneumatic devices: *Kirkhof Electric*, Grand Rapids,–western Mich.; *Hughes Industrial Products* Buffalo,–western New York; *Circuit Engineering*, Jacksonville,–Florida and southern Georgia; *William S. Brooks Co.*, Atlanta,–central and northern Georgia, eastern Tennessee; *Airdraulics Supply Co.*, Memphis,–western Tennessee, northern Mississippi and Arkansas.

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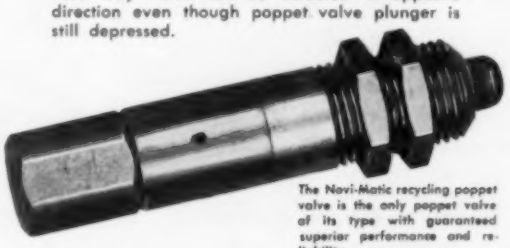
NOVI-MATIC'S RECYCLING POPPET VALVE:

Automatically and completely eliminates static air pressure from pilot chamber of bleeder-type air-operated valves. Pressing of plunger opens poppet at bottom of valve. Poppet remains unseated until all static air is released and then reseats while plunger remains depressed.

Four way valve can be actuated in opposite direction even though poppet valve plunger is still depressed.



The Novi-Matic recycling poppet valve is the only poppet valve of its type with guaranteed superior performance and reliability.

Novi-Matic's recycling poppet valves, in conjunction with Novi-Matic's 3-way and 4-way valves, have proven themselves in a multitude of operations such as the automation of machines for drilling, milling, handling, packaging, assembling, bag making, embossing, wrapping, sizing, box making, bag filling, sealing, counting, tagging, bottle filling, marking, stamping, weighing, and many others.

Perhaps our valves could help your particular industry. Why not try them?

Write about our other poppet, 3-way & 4-way valves.

Novi-Matic Valve Division
Novi Tool & Machine Co. Novi, Mich.

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Compressed Air Data You should have about damage caused by Water, Vapors, Acid fumes and Abrasives in the Air System

A study and discussion of compressed air and its inherent properties which cause corrosion, contamination, abrasion and freezing of pneumatic equipment are covered in 16-page brochure "*Moisture Control.*"

Now in its 26th printing, the brochure explains how the unique, low-cost Van-Air method extracts water, vapors, acid fumes and abrasives which normally flow past aftercooler and receiver—how these elements corrode pneumatic equipment and controls—damage products in process—contaminate exposed solutions.

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DOWN TO SUB-MICRON SIZE!

If your plant uses medium to large compressed air lines, you need Air-Maze Model PL Two Stage Compressed Air Filter-Separators. Exclusive two stage element construction affords over 99.9% efficiency in removing solid particles down to sub-micron size, as well as entrained liquids in the form of fine water mist and oil smoke. Collected liquids drain into the container for easy removal. Because of its large capacity it needs only occasional servicing which can be completed in minutes.

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ROCKWELL-STANDARD CORPORATION

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for higher PRODUCTION!

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■ Now...You can mount an unlimited number of Versa Series "A" Solenoid Valves as one integrated unit with these new Versa Co-Ordinate Assemblies. These assemblies make possible simplicity of design in both Hydraulic and Pneumatic operation, because only one inlet is required to feed the entire line of valves. Additional blocks can be added at any time and blocks with and without adjustable built-in bleed controls can be used together in one unit. ■ Combined with Versa Series "A" Valves these Co-Ordinates provide the most flexible and reliable Multiple Solenoid Valve Assemblies in the Control Valve field. Write for Bulletin # 960.

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VERSA PRODUCTS COMPANY, INC.
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AX-24

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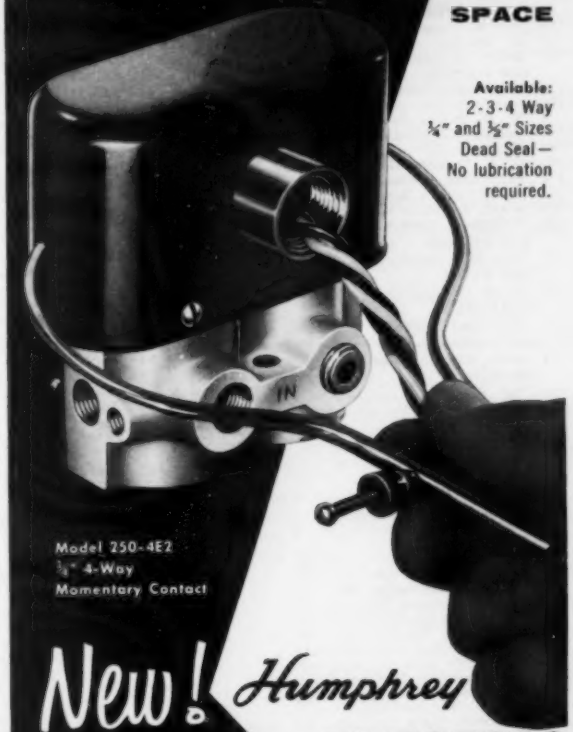
DESIGN BIG VALVE CAPACITY.....INTO SMALL SPACE



Available:
2-3-4 Way
¼" and ½" Sizes
Dead Seal—
No lubrication
required.

Model 250-4E2
¼" 4-Way
Momentary Contact

New! Humphrey ELECTRIC VALVES

SPECIFICATIONS
(¼" - 4 Way)

Pressure Range—30-125 PSI
Orifice Size—.250
Shipping Weight—3 lb. 4 oz.
Dimensions—4-5/16" x 4-1/4" x 2-3/8"
80.04 C.F.M. @ 100 PSI

EXCLUSIVE ELECTROPACT DESIGN
Coils—Epoxie Sealed, Metal Encased
Stroke (Sol.)—.022 Full

#250-4E2 Momentary Contact	#250-4E1 Maintained Contact
Voltage 115V 60 cycle	
Inrush 0.165	0.340
Hold 0.136	0.256

Other voltages available

Humphrey Products DIV.
General Gas Light Company Box 2008, Kalamazoo, Mich.

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FOR YOUR CONVENIENCE . . .

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100% CYLINDER CONTROL

DEAD-TIGHT SEATING OF ASCO 4-WAY SOLENOID VALVE PREVENTS PISTON DRIFT ...PERMITS PRECISION INCHING

3-POSITION, 4-WAY DESIGN

POPPET-TYPE SEATING— CANNOT STICK OR LEAK

INSTANTANEOUS OPERATION

EXPLOSION-PROOF ENCLOSURE AVAILABLE

PRESSURES UP TO 250 PSI ON AIR, WATER OR OIL

RUGGED BRASS BAR STOCK

2 SOLENOID CORES AND 4 DIAPHRAGMS ARE ONLY MOVING PARTS

Positive control of the cylinder piston is inherent in the design of this ASCO Bulletin 8347 valve. Leakage of air or liquid is made impossible, so that whenever both solenoids are de-energized, the valve assumes a center position and all orifices are blocked, locking cylinder piston in position. Dead-tight (poppet-type) valve seating permits precision inching of the piston, as well as absolute control of any length of stroke, with instantaneous stopping and not a trace of drift.

The utter simplicity of design and rugged construction assure many millions of trouble-free operations. You can choose the 8347 in either the ¼" or the ⅜" pipe size for pressures to 250 psi, and you can mount it in any position. It is available from stock for immediate delivery, as are other ASCO solenoid valves.

Write for Bulletin 8347, providing complete descriptive information on this new, reliable 4-way.

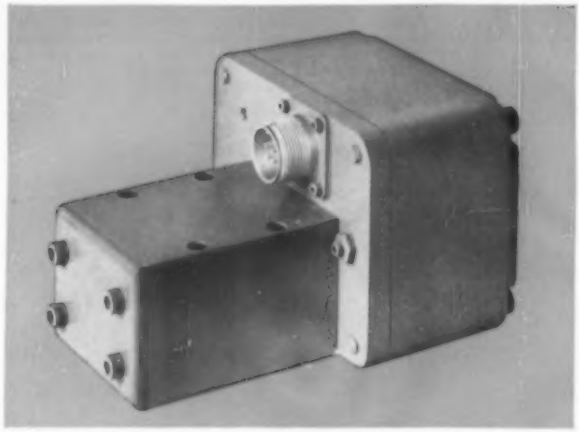
ASCO Valves ASCO

DEPENDABLE CONTROL BY Automatic Switch Co. 508 HANOVER RD., FLORHAM PARK, N. J. • FRONTIER 7-4800 • *AUTOMATIC TRANSFER SWITCHES • SOLENOID VALVES • ELECTROMAGNETIC CONTROL*

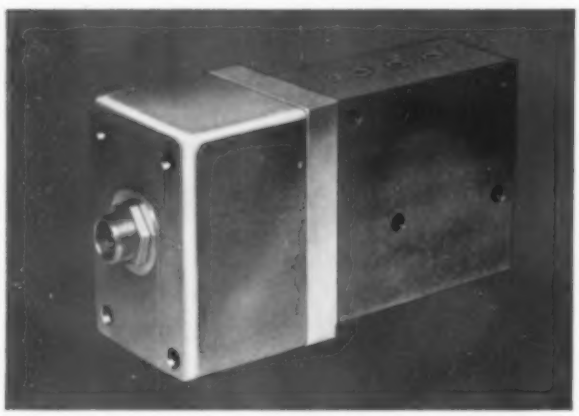
Circle **22** on Reader Service Card

Servo Valves To Match Your SPECIFIC Needs

Ruggedness, dirt tolerance, reliability, low cost and compatibility with standard hydraulic components featured in complete line



NEW series SC4 single stage servo valves are latest additions to the complete Vickers line. Rated at 0-3 gpm, they combine high performance with flexibility and ruggedness.



Two complete series of two-stage valves cover system requirements from 0-17 gpm and 0-37 gpm. With several models in each series, system needs can be precisely satisfied.

Extremely accurate flow modulation for fast, precise closed-loop control of position, velocity, and acceleration is offered in the complete line of Vickers servo valves. They are specifically designed for industrial applications with a range from 0 to 37 gpm.

Low cost of all servo valves in the line is the result of being designed for production economies. In addition, the inherent simplicity of the Vickers design pays off further when occasional service or cleaning is needed —in most cases the valves *do not have to be returned to the factory for service.*

Three Basic Series Available—A new single stage design rated from 0 to 3 gpm with 350 psi pressure drop, and two separate series of two-stage variable gain servo valves rated to 17 and 37 gpm, with 1000 psi pressure drop, are included in the line. Each of the two-stage valves is available in several models enabling the user to select the best valve for the job.

Designed To Take It—Temperature, dirt and vibration conditions normally encountered in industrial applications will not affect accuracy or performance of these servo valves when they are used with standard, 10 micron full flow filters. Both the single and two stage valves are equipped with large industrial, high force torque motors and will not clog or stick when operated with clean industrial hydraulic oils.

Part of Complete Line—Of equal importance for continued system accuracy and reliability, these servo valves are part of the complete line of high quality hydraulic products available from Vickers. Thus, responsibility for efficient operation of the entire hydraulic system rests with a single source.

Complete pre-engineered servo systems using the Vickers "Building Block" concept can be provided for many installations to reduce development and engineering costs. Such systems can include: servo valves, motors, hydraulic power supplies, electronic amplifiers, electrical feedbacks, etc.

Your nearby Vickers application engineer will assist you with your specific requirements or write, wire or call for Bulletins 59-74, 61-79.

VICKERS

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
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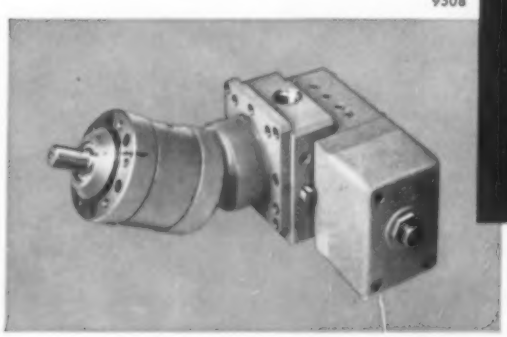
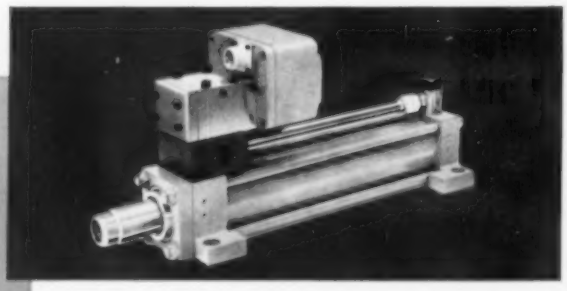
9508





Servo valves can be mounted separately or combined in one package with Vickers servo motors or hydraulic cylinders. All components for a complete system—either custom engineered or "Building Block"—are available from Vickers.

Circle **190** on Reader Service Card